Vol. VII. DECEMBER 1, 1879. [No. CLXIV.]

THE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

LONDON: HAUGHTON & COMPANY, 10, PATERNOSTER ROW, E.C.

JOHNSON & PHILLIPS,

TELEGRAPH ENGINEERS, ELECTRICIANS, & CONTRACTORS.

OFFICE: 16, UNION COURT, OLD BROAD STREET, LONDON, E.C.

WORKS: VICTORIA ROAD, CHARLTON, LONDON, S.E.

Manufacturers of all Telegraph Appliances, Materials, and Machinery for Making and Laying Submarine Cables, and Contractors for Underground & Aerial Telegraphs.

Iron Telegraph Buoys, Grapnels, both Patent and Ordinary; Centipedes, Creepers, Mushrooms, Sinkers, Cable Tanks, Picking-up and Paying-out Machinery, Dynamometers, Bow and Stern Gear, Steam and Hand Hauling Gears, Rope and Chain Fittings, Cable Drums, Splicing and Jointing Tools, &c., &c.

Machinery Designed and Constructed for the Complete Equipment of Telegraph Cable Factories and Vessels. Wire Testing Machines for Tension, Elongation, and Torsion. Special Wire Sounding Machines for Shallow and Deep Water.

All Apparatus and Material used in the Construction and Maintenance of LAND LINES, viz.:—

INSULATORS—*Johnson & Phillips's* Patent Fluid Insulators, and all kinds of the ordinary form.

BATTERIES—Sole Makers of *Higgins'* Patent Bichromate Batteries, and all the ordinary forms. Constructed for the supply of Zinc and Carbon Battery Plates of special quality.

POLES—Wrought Iron or Composite Poles of various kinds.

MAKERS OF SPECIAL UNDERGROUND TORPEDO AND FIELD CABLES, WITH SINGLE OR MULTIPLE CORES. Insulated Copper Wires, Strand and Rope, taped or braided, for Electric Lighting purposes, also Gutta Percha.

ESTIMATES GIVEN FOR COMPLETE SYSTEMS OF ELECTRIC LIGHTING.

LIGHTNING CONDUCTORS ERECTED, TESTED AND MAINTAINED.

ELECTRIC LIGHT.

SIEMENS BROTHERS,

TELEGRAPH ENGINEERS,

MANUFACTURERS OF

SIEMENS' PATENT DYNAMO-ELECTRIC MACHINES, LAMPS, CANDLES, and all APPARATUS necessary for working the [illegible] Stations, Wharves, Docks, Lighthouses, Ships, Factories, [illegible]

Manufacturers of Submarine Cables, Materials for Underground Lines, Land Lines, Telegraph Instruments, Batteries, Electric Mine Exploders, &c.

Contractors for laying Submarine Cables, &c.

Offices—12, [illegible]

Arch 25 [illegible]

AN ENGINE WHICH WORKS WITHOUT A BOILER OR STEAM.

AVERAGE WEEKLY DELIVERY
(including Contracted)
OVER TWENTY ENGINES.
1,000 ALREADY DELIVERED.

The durability of these Engines is now established by experience, one of them having run night and day at the Hindley Gas Works for over twelve months without any expenditure for repairs; the latter being equal to about 2½ years average work. Over 1,000 already delivered. Very numerous Testimonials from Users including Engineers, Men of Science, and others, on application to the Makers. No trouble with Coke Ashes, Smoke, Deleterious Water, or constant attendance. No glands to pack, or Water Gauges and Steam Gauges to watch.

STARTS AT A MOMENT'S NOTICE.

THE "OTTO" SILENT GAS ENGINE.

("Otto" and Crossley's Patents, 1876 and 1877.)

THEY ARE USED FOR ALL KINDS OF PURPOSES, CHIEFLY FOR HOISTING, PRINTING AND PUMPING.

Sizes { Nominal Horse-Power / Maximum Horse-Power } { ½ ¾ 2 3 4 6 8 10 12 16 } Offered.

Prices include Cast-iron Stand, Turned Fly-wheel, 2 Driving Pulleys, Water Vessel, Set of Duplicates, & Gas Fittings (excepting Meter & Pipes).

WORKS & HEAD OFFICES:
Gt. Marlboro' St., Gloucester St.

CROSSLEY BROTHERS,
MANCHESTER.

LONDON HOUSE:
115, Queen Victoria St., E.C.

DAVIS & TIMMINS,
SCREW MANUFACTURERS.

Binders, Terminals, Connectors, Clamps, &c., Kept in Stock.

BOWLING GREEN LANE, FARRINGDON ROAD, E.C.

INDEX TO TELEGRAPHIC JOURNAL ADVERTISEMENTS.

No charge is made for inserting Names of firms whose advertisements appear for at least three months consecutively in this Journal, during the continuance of such advertisements.

(The numbers refer to the page on which the displayed advertisements will be found.)

Cables Work.
C. Beach 3
J. J. Fenwick 3
W. H. Fenwick 3

Chemicals.
G. Hopkins 3

Electrical Apparatus.
J. & W. H. Archbutt 4

Electrical Engineers and Contractors.
A. Apps 10
Bell, Brooks & Co. 4
Bright, Clarke and Telegraph 1
Crossley Bros. 1
Forbes & Co. 10
Gower, Bell & Co. 10
Siemens Bros. 1

Machines for Plating.
Zamel & Bridges 7

Machinery.
Thos. Barraclough 3

Manufacturing Electricians.
Dale & Crampton 3
E. Paterson 2
Gibbins 1
F. Brooks 1
W. Ladd & Co. 9
Jackson & Co. 7

Metal Coils.
M. Sadler 7

Nickel Platers, Refining, &c.
H. Wiggin & Co. 4

Patent Agents.
Brewer & Jenkin 2
Robertson, Brooman & Co. 3

Photographic Apparatus.
Sciopticon Co. 3
Watton & Wainwright 3

Screws, &c.
A. Gamble & Co. 4
Davis & Timmins 2

Telephones.
Bishop, Vennett & Co. 4

Telegraph Instrument Makers.
Elliott Bros. 1
Hasler & Sons 1

TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

VOL. VII. DECEMBER 1, 1879. No. CLXIV.

CONTENTS:

	PAGE
Technical Education	383
Brooks' system of Underground Wires (*illustrated*)	383
Mr. W. L. Carpenter on Daily Practical Applications of Electricity in America	385
Glass Piercing by the Electric Spark, by M. Fages (*illustrated*)	386
Blowing up of the S.S. "Aden"	387
North Metropolitan Telegraph Messengers' Institute	387
Howell's Improved Battery (*illustrated*)	388
Lontin's Incandescent Wire Lamp, by G. E. Hospitalier (*illustrated*)	389
Elphinstone and Vincent's Dynamo-Electric Machine (*illustrated*)	390
Edison's Electrical Generator, by Charles A. Seeley, Ph.D.	391
Dr. Ager's Telegram Code	393
Notes	393
Proceedings of Societies	397
New Patents—1879	398
Traffic Receipts	400

PATENTS FOR INVENTIONS.

ROBERTSON, BROMAN, & Co. (established 50 years) continue to obtain Patents for Inventions. Pamphlet, containing special advice, gratis or by post. 166, Fleet Street, London.

TO INVENTORS.

MESSRS. BREWER & JENSEN, British, Foreign, and Colonial Patent Agents, give prompt personal attention to all matters intrusted to them. Office for Patents, 33, Chancery Lane, W.C. Established 1844.

GEOLOGY.—In the Preface to the Student's ELEMENTS of GEOLOGY, by Sir Charles Lyell, price 9s., he says:—"As it is impossible to enable the reader to recognise rocks and minerals at sight by aid of verbal descriptions or figures, he will do well to obtain a well-arranged collection of specimens, such as may be procured from **Mr. TENNANT** (149, Strand), Teacher of Mineralogy at King's College, London." These Collections are supplied on the following terms, in plain Mahogany Cabinets:—

100 Specimens, in Cabinet, with 3 Trays	£2 2 0
200 Specimens, in Cabinet, with 5 Trays	5 5 0
300 Specimens, in Cabinet, with 9 Drawers	10 10 0
400 Specimens, in Cabinet, with 13 Drawers	21 0 0

More extensive Collections at 50 to 5,000 Guineas each.

HARBOROW & Co.,
ELECTRIC TELEGRAPH ENGINEERS,
CONTRACTORS AND MANUFACTURERS,
4, Circus Street, Marylebone, W.

Makers of Block Instruments, Single and Double Needle Instruments, Coils for same with Induced Needles. Lines constructed and maintained. Batteries of every description. Electric Bells, Indicators, Thief and Fire Alarms for private houses, banks, hotels, warehouses, &c., &c. Lightning Conductors. All kinds of Electrical Mining Apparatus. H. and Co. draw attention to their Bells, &c., especially adapted for mines. Models made. Experiments carried out.—4, Circus Street, Marylebone, London, W.

BLOCK TELEGRAPHS AND ELECTRIC INTERLOCKING SIGNALS.
TYER & COMPANY

Respectfully invite the attention of Railway Directors, Managers, and Engineers to their important improvements in "Block" Telegraphs, especially to their new system (Patent 1874, in conjunction with Messrs. SAXBY & FARMER), inspected and improved by Captain TYLER, on behalf of the Board of Trade. By the use of this appliance, a signalman who receives a telegraphic indication of a line blocked from the signalman in advance, cannot possibly give a contrary signal upon the outside semaphore to the engine-driver.

"Such is the latest development of railway signalling, which is worthy of careful attention, constituting, as it does, a marked advance upon the ordinary block system."—*The Times.*

Office and Works—4, OLD STREET, GOSWELL ROAD, LONDON.

BRITANNIA RUBBER & KAMPTULICON Co.
WAREHOUSES:—32, CANNON STREET, E.C.
Works:—Bow Common, London, E.
MANUFACTURERS OF
EBONITE, SHEET, TUBE, AND ROD,
FOR
Electrical, Chemical, and Philosophical purposes.

OPERAS.

GENTLEMAN'S, 6s.; Lady's, 5s. 6d. Warranted Goods. Electric Bells from 6s. Improved Microphone and Battery in *one*, 2s. 6d. Double Line Wire, 1d. and 2d. per yard.
GIBBINS, 44, Parkfield Street, Islington.

MACHINERY for covering Telegraph Wire with Silk, Cotton, Flax, Hemp, India-Rubber, Gutta-Percha, &c. Wire Stranding Machines. Complete sets of Machinery for the Manufacture of Telegraph Cables.
THOS. BARRACLOUGH, 97, BRIDGE STREET, MANCHESTER.

TELEGRAPH INSTRUMENT CASES.
GEORGE BEECH,
10, SANDRINGHAM RD., HIGH ST., KINGSLAND,

Continues to supply Railway and Telegraph Engineers with every description of Telegraph Instrument Cases, Single Needle, Block, Bell, Switch, &c. The material and workmanship of first quality and guaranteed.
Terms moderate for Cash.

J. F. FOXCROFT,
Telegraph & Surgical Instrument Case Manufacturer,
39, LEVER STREET, GOSWELL ROAD.

Single and Double Needle Instrument Cases, Disc Cases, Morse Boards, Bell Cases, and every description of Cabinet Work for Electricians.
ESTABLISHED 1870.
Terms moderate for Cash.

PROF. HUGHES' INDUCTION BALANCE.

W. GROVES is the Sole Authorised Maker of Prof. Hughes' Induction Balance and all its Accessories, suitable for Metallurgical Analysis and Physical Researches.

W. GROVES,
Scientific & Telegraph Instrument Manufacturer,
89, BOLSOVER STREET, PORTLAND PLACE, W.

TELEGRAPHIC CABINET WORK.
WM. M. FOXCROFT,
54, COMPTON STREET, CLERKENWELL.
(Established 1844.)

INSTRUMENT CASES OF ALL DESCRIPTIONS.
Lock and Block, Single Needle, Bell, Sounder, and Telephone.
CABINET WORK DESIGNED TO SUIT NEW INSTRUMENTS.

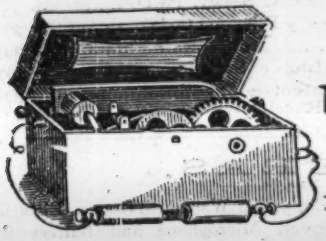
HENRY WIGGIN & COMPANY

(LATE EVANS & ASKIN),

COBALT AND NICKEL REFINERS AND GERMAN SILVER MANUFACTURERS,

BIRMINGHAM.

Anodes supplied for Nickel Plating, of any shape or dimensions.



M. SADLER,

INVENTOR OF THE

UPRIGHT MAGNETIC MACHINE,

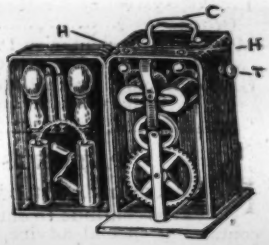
So universally used by the Medical Profession,

MANUFACTURER OF

Electrical, Galvanic, Magnetic, Chemical, Photographic and Pneumatic Apparatus.

Electric Bells and Indicators of every description.

For Hotels, Warehouses, Manufactories, Mines, and Domestic and General Use.



19, ASTON STREET, BIRMINGHAM.

A. COMBE & CO.,

31 & 32, KIRBY STREET, HATTON GARDEN, LONDON.

MANUFACTURERS OF SCREWS

OF ALL KINDS, AND SMALL WARES FOR

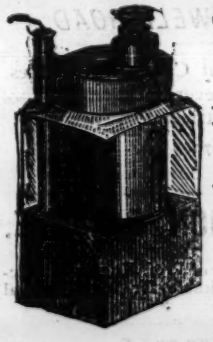
Electrical, Telegraphic, Optical, Scientific, Philosophical, Surgical, and Musical Instruments

ENGINEERING, &c., &c. TURNERY IN ALL METALS.

First-class work guaranteed. Estimates on application.

ELECTRIC HOUSE BELLS,

On the best system, from 5s. 6d. each.



Complete Apparatus—Bell, Battery, Button, 40 yards of Wire, and Book of Instructions, price 13s.

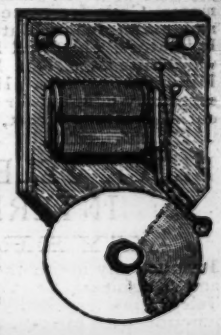
BURGLAR DETECTORS. FIRE ALARMS.

INDICATORS with Improved Relay. CONSTANT BATTERIES.

Wood and China PUSH BUTTONS. INSULATED WIRE.

HOUSES & MANSIONS FITTED. ESTIMATES GIVEN.

ILLUSTRATED PRICE LIST OF ELECTRIC BELL APPARATUS, post free.



TESTIMONIALS.

"MESSRS. ARCHBUTT, "Rugby, May, 1878.

"Your Electric Burglar Detectors fitted in my house last month have already proved efficient.—W. S. C."

"Scarborough, June, 1878.—You have fitted the Electric Bells in my house to my entire satisfaction.—D. P."

"Rugby, Sept. 24, 1878.—Your Burglar Detectors have three times lately been tested and proved efficient.—W. S. C."

Magnets of all descriptions. Silk covered Wire. Binding Screws, 3s. per dozen. Double Line Wire 1s. 6d. per dozen yards. Silk Cord, Switches, &c., &c. Telephone Signal Transmitters, 10s. 6d. each.

Just Published, "*Electric Bells, and how to Fix them.*" Thirty pages and diagrams. Post free, Six stamps.

J. & W. E. ARCHBUTT,

8, BRIDGE STREET, WESTMINSTER, S.W. (Facing the Houses of Parliament).

NEWALL'S PATENT LIGHTNING CONDUCTORS.

Experience, accumulated since the time of Benjamin Franklin, proves conclusively that a Conductor made of Copper, of adequate size, is the best of all appliances for the protection of every description of Building from the destructive effects of Lightning.

NEWALL & CO.'S PATENT COPPER-ROPE LIGHTNING CONDUCTOR

As applied to all kinds of Buildings and Shipping in all parts of the world with unvarying success, is the most reliable, most effective, and cheapest conductor offered to the public.

It is simple in its application, no insulators being required; and it costs only ONE SHILLING per foot for the standard size, which is safe in any storm.

SOLE PATENTEES OF UNTWISTED WIRE ROPE.

Manufacturers of Iron and Steel Ropes for Colliery and Railway Purposes. Rigging Ropes, Guide Ropes, &c.

GILT AND SILVER CORD FOR HANGING PICTURES. IRON, STEEL, AND COPPER CORD FOR CLOCK AND SASH LINES, &c.

R. S. NEWALL & Co., LONDON, 130, STRAND, W.C.

LIVERPOOL, 36, Waterloo Road; GLASGOW, 68, Anderston Quay; MANUFACTORY, Gateshead-on-Tyne.

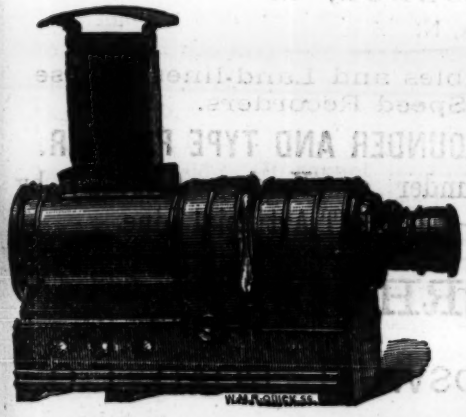
THE SCIOPTICON.

An improved form of Magic Lantern, burning paraffin oil, and giving a powerful light up to an 8 or 10 feet disc.

THE SCIOPTICON was the first of these lanterns introduced, and still holds its place as the best among a host of imitations.

The principle of the light is two *parallel* flames placed edgewise to the condenser.

Always ready—a few seconds only required to put in operation.



The **Improved Sciopticon** is the only Lantern in the market constructed on scientific principles. It is arranged so that the whole of the light from the condensers passes through the front lenses, the focussing being done *with the slide*, thus giving a greatly increased light on the screen and much better definition. **Price £6 6s.**

Catalogue of Sciopticons & Appliances.

SCIOPTICON MANUAL OF INSTRUCTIONS AND EXPERIMENTS.

13 Stamps.

Fourth Edition in the Press.

WOODBURY LANTERN SLIDES.

Superior to all other photographic slides, being permanent pigment photographs, and printed in transparent colours, every gradation of shadow is brought out on the screen. Their warm tone also contrasts most favourably with the cold photographic colour.

THE SCENOGRAPH.

A very light and portable Tourist's Folding Pocket Camera. By the New Dry Process, Chemicals are left at home, and the Sensitive Plates developed at leisure. No previous knowledge necessary.

No. 1. For Pictures 4¼ × 3¼, with lens stand and camera		...	...	...	35/-
No. 2. For Stereoscopes or Cabinets	„	...	...	...	50/-
No. 3. For Pictures, 7 × 5	„	...	...	...	50/-

Well adapted for use of Engineers, &c., for taking photographs of machinery or progress of works. Manual of Instruction (with Photo) seven stamps.

SCIOPTICON COMPANY,

157, GREAT PORTLAND STREET LONDON, W.

W. T. HENLEY,

TELEGRAPH ENGINEER AND CONTRACTOR.

MANUFACTURER OF SUBMARINE CABLES.

Wire and all Telegraphic Stores, also Galvanised and Corrugated Iron Sheets.

8, Draper's Gardens, Throgmorton Street, London.

WORKS—NORTH WOOLWICH.

GENTLEMEN desirous of having "THE TELEGRAPHIC JOURNAL" forwarded to them regularly can have it sent by filling up this form and returning it to the Publishers, 10, PATERNOSTER ROW, LONDON, E.C.

Please supply "The Telegraphic Journal" for the year 18 *, for which I inclose Post Office Order for*

Name _____

Address _____

Date _____

Subscription: Post Free in Britain, nine shillings and fourpence; to countries in Postal Union, ten shillings and fourpence. P.O. Orders to be made payable to HAUGHTON & CO., at the Chief Office.

NEW YORK: D. VAN NOSTRAND, 23, Murray Street, and 27, Warren Street. PARIS: M. BREGUET, 39, Quai de l'Horloge; Madame VEUVE J. BOYVEAU, Librairie Etrangère, 22, Rue de la Banque.
BERLIN: A. ASHER & Co., 5, Unter den Linden.

M. THEILER & SONS,

TELEGRAPH INSTRUMENT MANUFACTURERS,

86, *CANONBURY ROAD, LONDON, N.*

MANUFACTORY—ALWYNE LANE, N.

Specialties:—Patent Polarized Relays for Cables and Land-lines, Morse Instruments, Vibrating Sounders, Speed Recorders.

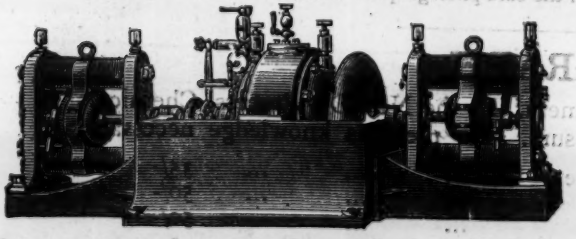
SOLE MAKERS OF THEILER'S NEW RECORDING SOUNDER AND TYPE PRINTER.

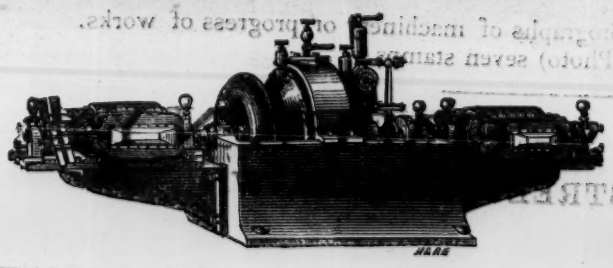
Contractors for Duplexing Land-lines (Morse Sounder or Hughes Circuits) by THEILER'S PATENT MECHANICAL DUPLEX—WITHOUT Artificial Line.

PETER BROTHERHOOD,

ENGINEER,

56 & 53, COMPTON STREET, GOSWELL ROAD, E.C.





SILVER MEDAL, PARIS EXHIBITION.

PATENT 3-CYLINDER ENGINES

AS USED BY

Siemens, Gramme, and Wilde,

FOR DRIVING

DYNAMO-ELECTRIC MACHINES

THE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

VOL. VII.—No. 164.

TECHNICAL EDUCATION.

THE recent lecture delivered by Professor Ayrton at the City and Guilds of London Institute on "The Improvements Science can Effect in our Trades and in the Condition of our Workmen," has called attention to the want of technical education which exists in England. In this particular branch of education the other European countries are no doubt ahead of us, but the beneficial results of this training, we think, are, at present at least, by no means so apparent as enthusiastic professors would have us suppose. Technical education in England, it is true, is, at present, not carried on to the extent that it is in the European States; and in America, we believe, it is equally behindhand; yet we must confess we fail to see that either the English or American scientists and engineers are being ousted by the foreigner. Why is this the case? Compare any of the laboratories or workshops attached to the English schools or colleges with the large and well-fitted establishments we find in France, Germany, Russia, and Switzerland, and the result will be decidedly unfavourable to our own country, both as regards the numbers and completeness of the same. With such advantages, which, we believe, are fully appreciated and made use of, how is it that we are not beaten quite out of the field? It cannot be that English or Americans are superior in intellect to the rest of the world. Is the answer to be found in the fact that the technical education in the foreign schools and colleges is not such as to train the mind so as to enable it to apply the knowledge with which it is stored? It is not sufficient that the theory of a subject be thoroughly understood unless the proper way to apply it in practice be also thoroughly explained. It is the constant expression of practical men that "it is all very well in theory, but practically it does not answer," the fact being that those who advanced the theory, or who have had it instilled into them, not only lack the practical knowledge, but the way to apply the theory to the practical knowledge. This may partly arise from the appliances for studying the theory being of a too perfect nature, that is to say, from their not leaving sufficient difficulties to be overcome, the laborious overcoming of which often teaches a vast deal more than the easy following out of a theory by complete appliances. Perhaps the majority of the most wonderful discoveries in scientific research have been made with the simplest apparatus. The well-known story of Sir Humphry Davey, who, when asked to show the laboratory in which he made his renowned researches, produced a small tray with a few articles of everyday life on it, together with a few bottles of common chemicals, is an instance of the kind.

Let it not be thought, however, that we would discourage the extension of technical education. The question we would ask is this—Is technical education, as it at present exists, the means of advancing scientific knowledge to the advantage of the nation at large? Does it not require to be supplemented in some way, and is it conducted on a correct basis? Professor Ayrton states that the reason why our engineers have hitherto been considered the first in the world is because they started earliest in the race; but even if we may be considered to have fallen behindhand, the case is not so with America, and we are not aware that technical education is very advanced in that country.

BROOKS' SYSTEM OF UNDERGROUND TELEGRAPH WIRES.

A SYSTEM of underground telegraph wires has been recently invented by Mr. David Brooks, of the United States (a gentleman well known in the telegraphic world as the inventor of the "Brooks' Paraffin Insulator"), which bids fair to be of very great value to telegraph companies and administrations.

The peculiarity of this system lies in the insulating material, which, instead of being a solid, is a liquid. In carrying out the system, the conducting wire or wires are first covered with hemp, cotton, jute, or other cheap absorbent material, which latter is then saturated with melted paraffin wax. The wires thus insulated are then drawn into a tube, which is kept filled with paraffin oil.

The preliminary insulation of the clothed wires with paraffin is not essential to their complete insulation, and if the fibrous material with which the wires are clothed be entirely deprived of moisture and gases in the first instance, ordinary petroleum and other liquids, after they are rendered anhydrous, may be used as insulating media, providing they are maintained in constant and intimate contact with the clothed wires.

The preliminary heating of the clothed wires or cable of wires may be effected in different ways. They may, for instance, be subjected in an oven to a temperature of 300° to 320° Fahrenheit for a sufficient length of time to ensure the evaporation of all the moisture contained in the fibrous wrapping and the evolving of all the gases generated by subjecting the fibres to heat, and then (preferably while it is hot) steeping the cable in heated petroleum or other insulating liquid.

Another plan is to first steep the clothed wires or cable of wires in oil—petroleum or linseed oil, for instance—or other liquid which will not evaporate at a temperature of 350°, for the bath should be

maintained at about that temperature. After this has been done, the cable may be boiled in water in which chlorine or bleaching powder has been dissolved, so that all traces of acids or gases may be removed. As the clothing of the wires is made somewhat tender by the above treatment, the cable may be wrapped with hemp, jute, or other cheap fibrous strands. The cable is then placed in a bath of any liquid insulating medium—common petroleum, for instance—the said bath being maintained at a temperature of about 230° Fahrenheit, and this steeping is continued until the insulation resistance ceases to increase. The cable being now deprived of all moisture and gases, and thcroughly insulated, is pulled through a pipe—an ordinary lap or butt welded iron tube, for instance—in doing which the fibrous clothing of the wires is protected by the above-mentioned wrapping.

Before the cable is pulled into the pipe, the interior of the latter is deprived of all moisture. This may be done by heating the pipe or by introducing into it pulverised quicklime, which absorbs the moisture.

The manner of connecting together the pipes containing the cables and maintaining the wrappings in a proper insulated condition after the pipes are laid, will be best explained by reference to the accompanying figures.

In Fig. 1, A is the iron pipe through which the wires run, and which is kept filled with the insulating oil. As it is necessary to have joint-boxes at certain distances along the line, these boxes are constructed in a chamber form, as shown by C. This chamber is made in two pieces, the lower of which has sockets into which the pipes are screwed. The upper part of the chamber is screwed into the lower, so that it can be removed if necessary, and the joints of the wire got at. P is a small plug screwed into the top of the chamber, which can be removed when the pipes are being filled with oil, so that the contained air can escape and the oil rise in the chamber and cover the joints *i*. The joints in the wire are made in the ordinary manner by twisting the ends together, soldering them, and then wrapping them over well with the cotton covering. In order to expel any moisture in the chamber, the latter is heated when the oil is poured in.

The oil which is placed in the pipes is by preference refined petroleum, which Mr. Brooks finds, as the result of numerous experiments, to be better than any other kind of liquid.

A supply of this oil is contained in a reservoir T, as shown by Fig. 2. The supply pipe is connected to the main pipe A containing the wires, by a T piece C, as shown. The height of the reservoir or reservoirs—for a long length of line several may be employed—is such that the insulating liquid in the pipes at all points on the route will be under constant pressure, to secure the best insulation and to effectually seal the interior of the pipes and protect the cable from moisture.

The pipes employed are of iron, $\frac{3}{8}$-inch thick, and are in 5-feet lengths. They are made of "Juniata" iron, which is of a peculiarly tough and flexible nature. If necessary, the pipes can be joined up in

FIG. 1.

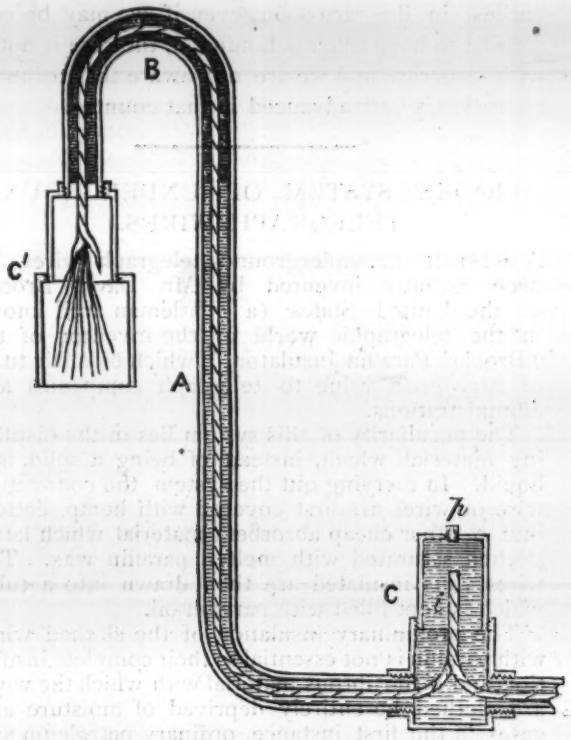
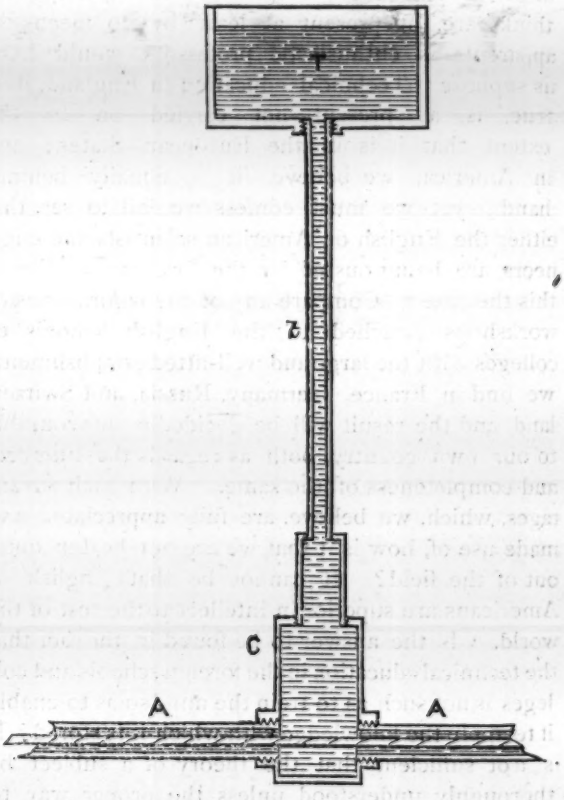


FIG. 2.



half-mile lengths. The joints of the pipes with one another and with the joint boxes are rendered tight by means of silicate of soda, as it is found that the white or red lead packing usually employed for similar purposes will not resist the action of the oil.

The way in which the wires are led into the test-boxes at the offices is shown in Fig. 1. The pipe is brought in by a bend B, which is filled with a solid material called "Tunyoap," a product of petroleum, shown by the shaded portion.

Two sockets, one larger than the other, are screwed one into the other and on to the end of the pipe, as shown. The wire cable, being brought out at this mouthpiece, is untwisted, and each wire led away to the test-box terminals in the office.

The Brooks' system of underground wires has, among others, the following advantages :—

1st. Its cost, where as many as twenty conductors are upon one route, is only about half that of the same number of conductors when strung upon poles. As the number of conductors increase, or the greater the number of wires in one tube, the less the expense per wire. Double wires for telephone circuits cost only about four dollars per mile ; they are made of No. 24 Birmingham gauge. 150 of these coated wires can easily be drawn into 1-inch pipes.

2nd. Durability. There is nothing in the system perishable except the outside of the iron pipe. The pipe will last more than twice as long as when used to distribute gas or water, for then oxydation is most rapid on the inner surface of the pipe. No chemical changes take place with the copper conductors, the inner surface of the pipe, the cotton covering, or with the oil itself, which is the most stable of known substances. It is neither affected by acids, alkalies, or re-agents of any kind, but remains in the same condition in the pipe as it has for ages in the earth.

3rd. The insulation is equal to that of gutta-percha-covered underground conductors.

The electro static capacity is not over one-tenth of that of conductors insulated with gutta-percha ; but as the covering is much thinner where cotton and oil are used, the specific inductive capacity is less than the one-hundredth that of gutta-percha.

4th. The conductors, being sealed in a pipe, are not interrupted by breaks, contacts, and other causes which affect overhead wires, and the electrical condition of the conductors being constant and unchangeable by atmospheric conditions, are capable of being worked to much greater capacity, especially so when the duplex, quadruplex, or automatic systems are employed.

5th. Telephone circuits are worked by this system without perceptible inductive disturbance from currents upon the other wires, in the same pipe, or any cause whatever.

The system has been laid across the Dalaware river, which is 3,700 feet across at its surface. 4,000 feet of cable, containing forty-four conductors, has been used for the purpose. The Irrawaddy and the Christiana rivers, and many others, have also been crossed by means of Mr. Brooks' system, and with perfect success.

A trial of Mr. Brooks' system has been made in Belgium, and the results of tests made there by Messrs. Dumont and Girard, of the Belgian Government telegraphs, are as follows :—

A test of a length of 7,883 metres, when fresh laid, showed an insulation resistance of 1787·9 megohms per kilometre. A test of the same wire made later on in the day, gave 1656·9 megohms. A test made nine days later showed that the insulation had fallen to 451·3 megohms ; tests on intermediate days showed that this fall had been gradual. These tests were made after one minuts'e electrification. A subsequent test after ten minute's electrification, made about five weeks later, showed a result of 439·5 megohms. Three weeks later the oil was renewed, and the insulation ran up to 2,000 megohms per kilometre.

Mr. Brooks states that the fall of insulation in the first instance is due to the oil absorbing moisture from the cable and pipes, and that after the oil is renewed the insulation remains permanent.

Inductive capacity tests gave an average result of ·013 microfarad per kilometre.

We understand that the Western Union Telegraph Company have purchased the United States patents of Mr. Brooks for this system for 331,500 dollars.

MR. W. L. CARPENTER ON DAILY PRACTICAL APPLICATIONS OF ELECTRICITY IN AMERICA.

A MOST interesting lecture was delivered by Mr. W. Lant Carpenter, B.A., B.Sc., on Monday, Nov. 10th, at the British Museum and Library, Bristol, the subject being : "Daily Practical Applications of Electricity in America."

Mr. Carpenter, at the commencement of his discourse, remarked that amongst the various improvements and things which were being tried in the United States, America, one that struck him as much as anything was the extraordinary development, within the last two or three years, of the application of electricity to the purposes of practical life. He then explained, for the benefit of the unscientific, the action of a battery in producing magnetism, heating platinum wire, &c. Passing on to the construction and working of electric bells, the lecturer explained their action. Examples were given of the ringing of bells in this way—house bells, mining bells, &c. The practical application of the system to use in dwelling-houses, for the purpose of burglar alarms, &c., was also fully explained, the lecturer pointing out that matters were, of course, so arranged that the circuit of electricity was only kept up by night, and allowed to be broken by day. He gave several remarkable examples of the way in which the system is applied in the United States for the protection of safes, vaults, and other valuable property, alarms being rung in a central office whenever a forcible entrance was attempted in any one of, say, 500 vaults, the alarm indicating which one. The principle of the system was as follows :—The safes are covered externally, and the vaults lined internally, with a continuous casing of two *thin* sheets of metal, separated by an insulating material. The two sheets are connected in the circuit of an ordinary electric bell, placed in the watchman's room, or in any other place where it is advisable, to sound an alarm. If any attempt is made to break into the safe or vault, it must be done through the two

metallic sheets and insulating material; the result of this is to bring the two metals together, and complete the circuit, and this is *sure* to take place, however great care be taken in making the breach of the burglar, even supposing he knew what he was about, and used a non-metallic tool, which, of course, would not be the case.

Most safes are protected with both closed and open circuits; the former rings a bell when a "scientific" burglar cuts the connecting wire.

Mr. Carpenter also explained another mode of protecting safes and strong-rooms by means of "time," or clock locks, which only permit of their being opened at a given hour. The obvious difficulty which would arise from the stoppage of such clocks before the hour at which their action released the bolts of the safe door, was got over by means of an electro-magnetic arrangement, which could be caused to actuate the clock by a step-by-step motion, and could thus bring it round to the required hour. These clock locks, it was stated, are largely used.

An electric watchman's "tell-tale," the invention of Mr. Batchelor, is employed in some factories. Keys are placed all over the building, to be depressed by the watchman when he goes his rounds; this operates a registering pencil in a clock. The register-sheet, which is changed daily, and which is placed in the manager's office, cannot be got at by the watchman. The man's whereabouts at any hour or minute is thus permanently registered, and can be checked in the morning.

Mr. Carpenter next described the well-known system of call-signals, so extensively used in America.

In speaking of the practical application of electricity to a system of fire-alarms, Mr. Carpenter explained the general system pursued in all large towns in the United States, and spoke of the extraordinary rapidity with which fire-engines are turned out ready for use on receipt of the electric signal. Six or eight seconds was the usual time. Electric signal boxes were fixed in the streets, and any person, on becoming aware of a fire, could turn a handle and communicate at once with the central stations, where the officials would know from which box the signal came. An automatic system was at work in New York, where 500 shops, stores, and warehouses were protected by an apparatus which sounded an alarm in a central office whenever the temperature of any place rose above a given point. Insurance companies charged less premium on places so protected. The statistics of the former are simply startling as regards the efficiency of the apparatus. It has been in successful operation for three years now, and over 100,000,000 dollars' worth of property are now thus protected in New York alone.

The lecturer next alluded cursorily to the electric telegraph, including multiplex telegraphy. In speaking of the electric light, Mr. Carpenter remarked that Mr. Edison claimed to have sub-divided it in such a way that instead of its being necessary to have one very intense light, there might be arranged a great number of less intense lights produced out of the same current. But, as a matter of fact, such had not been done yet for practical daily use. He (the lecturer) was in Mr. Edison's laboratory some few months since, and, as far as he could see, he was no nearer to that than he was two years ago. He did not believe very much in its practical utility for the purposes of street-lighting, and for domestic purposes he was not in the least afraid that it would supersede gas; it was, however, very well suited for the illumination of large halls or spaces.

The next subject was "Telephones," in considering which the lecturer discoursed on their first practical discovery by Dr. Alexander Graham Bell; he then explained how, in Bell's and other Magneto Telephones, electric currents are excited by vibration of an iron disc or diaphragm, set in motion in front of a magnet by the voice; the Microphone of Professor Hughes and Edison's Loud-speaking or Electro-chemical Telephone were also explained.

In speaking of Telephone Exchanges, their recent extraordinary and rapid development in every large town in the United States, and their uses and advantages, were alluded to, and a hope expressed that the subscription for those to be set up in England would be as low as possible, in order that a considerable number of Bristolians might join such an exchange, which Captain Cox and other representatives of the company present were promoting.

In conclusion, Mr. Carpenter urged that if science, practically applied, was to form so large a portion of our daily life, was not that a very strong argument for so arranging our educational work that every child should be instructed in the rudiments of science?

The lecture, which was attended by a crowded audience, was excellently illustrated by views* for the oxy-hydrogen lantern, and by apparatus, a large portion of which was now shown for the first time in England.

GLASS PIERCING BY THE ELECTRIC SPARK.

By M. FAGES.

WHEN the glass, which it is proposed to pierce, is thick, one of the wires from the induction coil should be bedded in a casing of resin sufficiently thick and solid, on one of the faces of the plate of glass. This operation, necessitating the employment of heat, is tedious, irrespective of the fact of the difficulty of removing the resin from the glass when the operation is completed.

The following method is very easy of application, and all the necessary preparations can be made in a very short time.

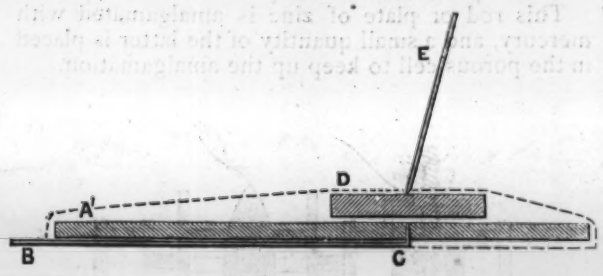
It is first of all necessary to have a small apparatus which lasts indefinitely, and the simplicity of which is such that any one can construct it for themselves. This apparatus is shown in vertical section by the fig.; it is composed, 1st, of a rectangular plate A of ebonite; 2nd, of a brass wire B, the curved point C of which is fixed or screwed tightly in the plate of ebonite, and is flush with the surface of the same, as shown. This is the whole apparatus.

When it is required for use, it is placed horizontally on the experiment table, or on any other support, and the brass wire B is put in connection with one of the terminals of the induction coil. This done, a few drops of olive oil are dropped on the ebonite

* Copies of these views may be obtained from Mr. Edwar Paterson, of Bedford Street, Covent Garden.

plate around the point C, and the glass plate D, which is to be pierced, is placed over it, care being taken that no bubbles of air are enclosed between the glass and the oil. The olive oil answers perfectly its purpose of insulating the point C. It is probable that any other oil would do equally well.

The things being thus arranged in position, it only remains to place the wire E which is connected to the other terminal of the induction coil, and to make the spark pass.



By displacing the glass laterally, it is very easy to pierce it in a few moments with several holes close to one another.

The single essential condition to be observed in order to make the experiment satisfactorily, is to have the plate of ebonite sufficiently large. It is necessary, in fact, that the spark may be unable to burst out between the wires by following the route indicated by the dotted lines.

BLOWING-UP OF THE S.S. "ADEN."

A very difficult piece of engineering work has been most efficiently carried out by the students of the Imperial Torpedo College, at Taku, China.

An old Peninsular and Oriental steamer, the *Aden*, was moored outside the Taku Bar, some seven miles off the land, where she was used as a receiving hulk and light-ship by the China merchants' Steam Navigation Company. On a fine calm morning, while unloading cargo, with a steam lighter lying alongside her, she suddenly capsized, sinking immediately, and drowning fifty of the coolies employed upon her. At first some hopes were entertained of raising her, as she was only just covered at low tide; but, being an old iron vessel and lying in a heavy sea-way, she began to break up so quickly that all thoughts of getting her up were abandoned, and as she was a source of great danger to other vessels arriving at the bar, it was determined to blow her up. Mr. Betts was requested to undertake the work, with the assistance of some of his students; divers were sent down and the position of the vessel carefully marked out. It was found that the stern of the ship was washed away, and the whole of the after-part sunk in the mud out of sight, leaving the bows sticking up. From the position of the wreck, it was determined to place three heavy torpedoes in her and fire them simultaneously. One 700 lbs. charge was placed well forward in her bows, and a 500 lbs. charge in the waist of the ship on each side. The charges were submerged at low tide, joined up in divided circuit, and the main cable carried to the steam-tug in attendance. At high tide, when covered by about twenty feet of water, they were fired, causing a grand effect. An immense amount of wood and several dead bodies came to the surface, while hundreds of fish of all sorts and sizes went floating by. On an examination being made by the divers, it was found that the bow of the wreck had been blown off in one mass, while the remainder of the vessel had been entirely broken up and sunk into a deep crater which the explosion had formed in the mud.

As Mr. Betts was compelled to return to Tientsin, the work of breaking up the bow was entrusted to the chief student, Chan Yu Chun, who decided that it would be best to attack it in detail, using 120 lbs. charges to destroy each rib or beam. Seventeen of these charges were used, when it was found that every portion of the wreck was entirely submerged in the mud, the divers sweeping over it for several days without finding the slightest evidence of the vessel.

Gunpowder was the explosive employed, as no other material was at hand. Platinum wire fuses and the Silvertown firing battery were used to ignite the charges.

The work was one of considerable difficulty, as it was carried out at a season of the year when heavy squalls are of almost daily occurrence, and at a spot where hundreds of junks and fishing-boats, in addition to the steamers, are always about.

NORTH METROPOLITAN TELEGRAPH MESSENGERS' INSTITUTE.

WHO is there, residing in London, or indeed in any large town in Britain, who does not know that merry, agile, and useful member of society, the telegraph messenger-boy? Sometimes the medium of most extensive business operations, and sometimes the bearer of relief-giving messages, or words fraught with acutest pain. For such, the above institute, which is now domiciled at St. Stephen's Hall, Providence Place, Upper Street, Islington, is intended. By paying a small subscription, youths in the Postal Telegraph Service between the ages of 14 and 21 are entitled to use the rooms of the Institute, where educational classes, reading-room, and reference library are provided, and to which it is hoped will soon be added a lending library.

An additional building has been taken for the convenience of orphan members, or for those who are living far from their parents, so that they may have a comfortable home adjoining the Institute.

A debt of £50 having been incurred upon removing from Canonbury Tower to the above premises, for repairs, furniture, and needful appliances, it was decided to hold a bazaar on November 11th, 12th, and 13th, for the purpose of extinguishing it. The opening address was given by Mr. W. T. Paton, Esq., who, in declaring the bazaar open, expressed the sympathy he felt with the efforts of those who

had promoted it. He had a strong admiration for that German writer who said, "I hope I shall never be so much of a man as to have none of the boy about me." It seemed as if all his life was cast among boys, and he was able to say that every effort he had made for young life, either in this parish or out of it, had been repaid three-hundredfold. (Cheers.) It was a remarkable fact that this institution had had its first origin in a quarrel amongst four telegraph messengers, which was amicably settled by the honorary secretary, Mr. F. C. Bourne, who afterwards conceived the idea of forming telegraph boys into a brotherhood, which should aim at their improvement religiously and socially, and aid their advancement in life. What was required was, that institutions which sought to make the younger generation good and useful members of society should be supported, and any assistance which they might give to so good a work would be rewarded both in this life and hereafter. (Hear, hear.)

The general arrangements of the bazaar were superintended by the honorary secretaries, Messrs. F. C. Bourne, S. H. Langham, and J. O. Baxter. The little hall was well filled with stalls stocked with fancy articles, and presided over by Miss Langham, the Misses West, the Misses Charles, the Misses Sansom, the Misses Nicholl, Miss Shaw, Miss Tailby, Miss Milne, and Miss Bourne. Mrs. Sturgess, the matron of the Northern Postal Telegraph Office, and who takes much interest in the Institute, and greatly encourages the boys, took charge of the woolwork division. We are glad to be able to add that the enterprise was a thorough success; the debt, after paying all expenses, has been wiped out, and a balance of £5 left in hand.

HOWELL'S IMPROVED BATTERY.

THIS battery is shown by the figure. It consists of an outer jar of stoneware or glass. Inside this jar is placed a cell or tube B, either with or without a bottom; this cell or tube, which is termed the "separator," is made with a number of narrow slots or openings in it in the direction of its length, the slots being of sufficient width to allow free passage of any fluid, but not so wide as to allow much of a mixture (which will be referred to further on) in the compartment A^1 formed by the outer jar, to pass through. The "separator," which rests upon the bottom of the outer jar and extends to the same height, may be made of stoneware or glass.

Inside the "separator" is placed an ordinary porous cell C, thus forming altogether three compartments.

In the outer compartment, or the compartment formed by the outer jar and "separator," is placed an ordinary plate or rod of carbon N, having the usual terminal for connecting purposes firmly attached to the top.

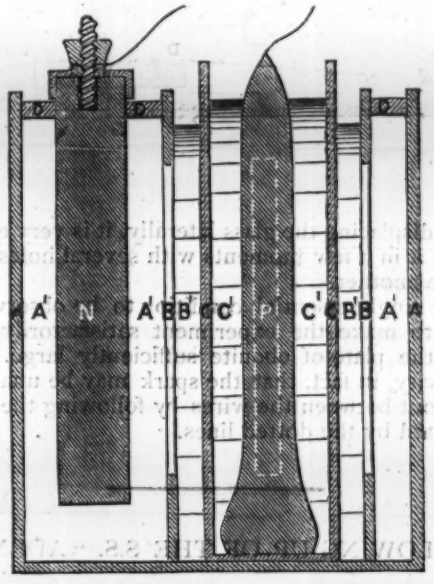
Surrounding the carbon or graphite plate and the "separator" is placed a mixture made up of ordinary peroxide of manganese or broken charcoal or graphite, also a quantity of sulphate of manganese (known commercially as white manganese).

For safety in transit, the mixture, as at D, may be sealed up with some suitable compound, such as marine glue or pitch, in which are made perforations to admit of the escape of gases, which perforations will also admit of a supply of saturated manganese being poured into the outer compartment when the battery is found to be weakening.

In the middle compartment B^1, formed by the slotted "separator" and the porous cell above mentioned, is placed a solution of sulphuric acid and water, which penetrates the slots in the "separator," and impregnates the mixture of manganese and carbon.

For the positive electrode, in the porous cell or inner compartment, a rod or plate of zinc P is placed.

This rod or plate of zinc is amalgamated with mercury, and a small quantity of the latter is placed in the porous cell to keep up the amalgamation.



In compartment C^1 of the porous cell C, containing the zinc rod or plate, is placed a solution of hydro-sulphate of ammonia and water.

The advantages of the whole arrangement of the improved galvanic battery are the following:—It has greater electro motive force, and retains the same for a more lengthened period (when worked under the same conditions) than any other form of peroxide of manganese and ammonia battery; it also admits of the removal of the porous cell for cleaning purposes without disturbing the mixture in the outer compartment, or compartment formed by the "separator" and the outer jar, so that salts may be removed, and the zinc amalgamated readily.

The mixture of peroxide of manganese with the sulphate of manganese has a higher conducting power than the peroxide alone; consequently, the resistance of the battery is very low.

WE purpose in an early issue to commence a series of articles fully descriptive of the apparatus and *matériel* employed by the British Postal Telegraph Department.

LONTIN'S INCANDESCENT WIRE LAMP.

By G. E. HOSPITALIER.

ELECTRIC lighting by incandescence, although more relatively costly than lighting by the voltaic arc, nevertheless possesses certain advantages which recommend it for certain special purposes.

The greatest obstacle which up to the present has stood in the way of this method of illumination, has existed in the difficulty of preventing the fusion of the incandescent wire by an excess of current caused by an increase in the velocity of the Gramme machine, or from other causes.

M. Lontin has solved the problem in a very elegant manner by the regulator shown by Fig. 1.

The current enters by one of the terminals of the lamp, traverses direct the wire of an electro-magnet, and then

FIG. 1.

tro-magnet and the terminal at which the current leaves is connected with a little vertical spring, carrying at its upper extremity a small armature placed opposite the pole of the magnet. A small antagonistic spring, which can have its tension regulated by means of a thumbscrew, enables the vertical spring to resist more or less the pull of the electro-magnet.

So long as the current only attains a certain strength, the little armature fixed at the top of the vertical spring remains unattracted by the electro-magnet, but if the current exceeds this strength, the electro-magnet attracts the armature until it makes contact with the pole of the former. It thus establishes a direct route for the current, which then

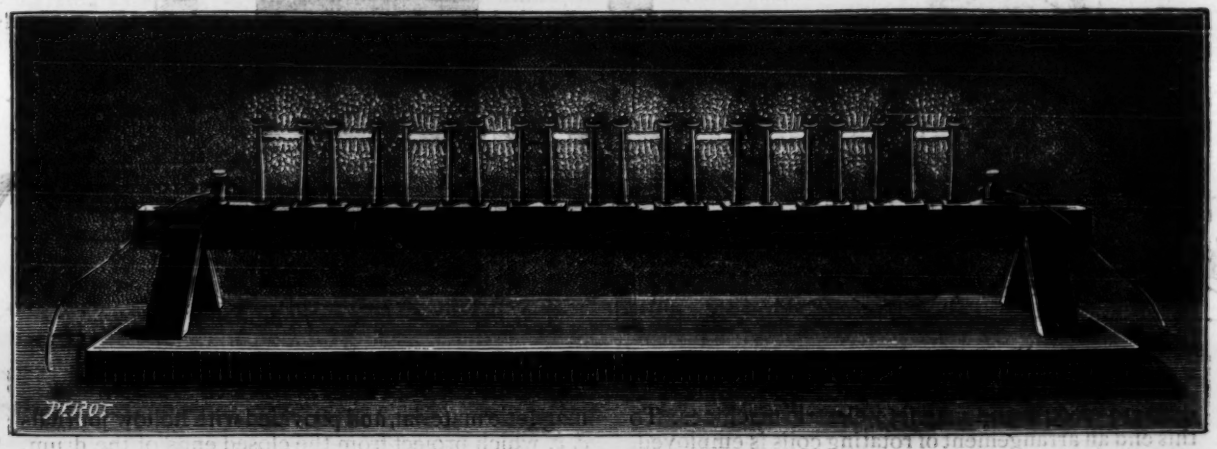


FIG. 2.

passes through the wire spiral which is to be heated by the current, and thence passes back to the generator by a second terminal.

The terminal at which the current enters is also connected with the iron core of the electro-magnet direct, and allows but a very small portion to pass through its coils; in fact, short-circuits the electro-magnet, and also the wire spiral, which is thus prevented from

fusing. The electro-magnet, being short-circuited, loses its attractive power, and ceases to attract the vertical spring, which latter falls away from the pole of the electro-magnet, thereby again allowing the current to traverse the spiral wire and the electro-magnet. By this means, then, if the regulating spring be strained up to any particular tension, the requisite amount of current can be made to flow through the platinum wire.

A single regulator can serve several lamps at the same time, as shown by Fig. 2, which shows a chain of 10 wire spirals, maintained at any required temperature by means of the regulator described. The 10 lamps are shown as joined up in series in the same circuit. The spirals are made of platinum wire, one millimetre in diameter. The total length of wire in these 10 spirals is 2½ metres approximately, though the total length of the spirals themselves is of course less. It is possible to keep 12 spirals, like those shown, incandescent by employing an 8-bobbin Lontin machine. With a 24-bobbin machine, 36 spirals can be kept luminous, and thus produce 36 lights.

The arrangement is a sensible advance towards effecting the sub-division of the electric light. Photometric experiments will show if there is a real gain in thus pushing so far a division which, up to the present, has been so unfavourable to electricity as a means of light. We must give M. Lontin the credit of having proved the *possibility* of sub-dividing the light; the day is, perhaps, not far distant when it will also be *economical*.—*La Nature*.

ELPHINSTONE AND VINCENT'S DYNAMO-ELECTRIC MACHINE.

THE object of this invention is to obtain electric currents with a less expenditure of motive force than has hitherto been required in working dynamo-electric and magneto-electric machines. To this end an arrangement of rotating coils is employed, so applied as to cut the lines of magnetic force, and thereby induce in the coils powerful currents of electricity, which may be used as intensity or as quantity currents.

Fig. 1 is a transverse vertical sectional view; and Fig. 2, a longitudinal vertical section taken through the centre of the machine. In these Figs., A, A, are two standards connected together by the bridges B, B, B, so as to form the framing of the machine. Mounted in bearings in the standards A, A, is a hollow drum C, made of brass or some other non-magnetic material, and provided with hollow journals *c*, *c*, which project from the closed ends of the drum. Upon one of these journals, and external of the framing, is keyed a driving pulley D. On the outer periphery of this drum any suitable number of coils of insulated copper wire E, E, is placed.

The method of laying the coils will be better

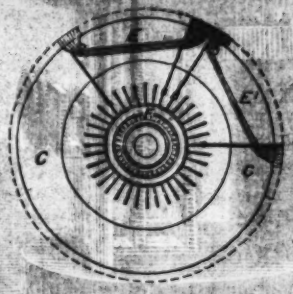


FIG. 3

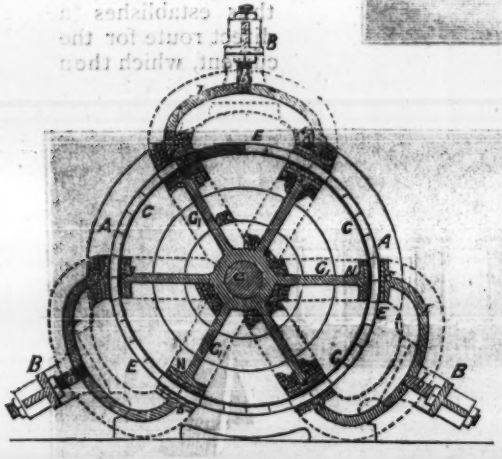


FIG. 1.

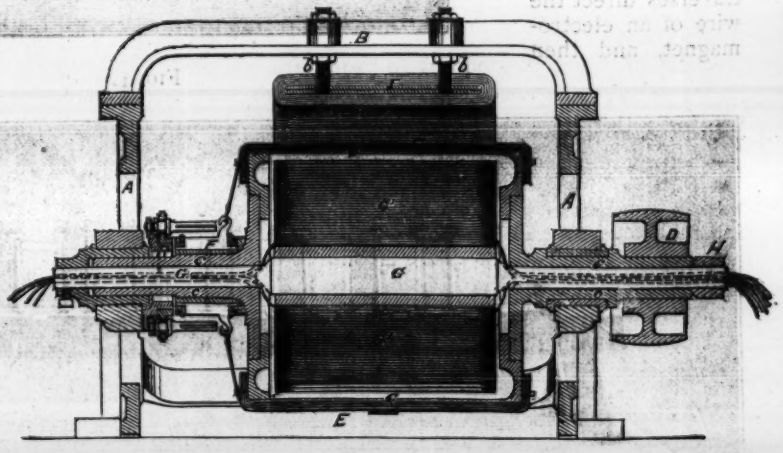


FIG 2.

understood by referring to Fig. 3, which represents an end view of the drum and commutator detached, and with two coils placed on it. The wires forming these coils are laid parallel with the axis of the drum from end to end, and over the ends or heads of it, E representing the end of one coil, and E^1 the end of another coil, the free ends of each coil being connected with a commutator F.

By this mode of forming the armature coils, a large proportion of the wire is rendered efficient, and the amount of useless internal resistance is consequently reduced.

Mounted upon a dead shaft G, which passes through the hollow journals of the drum C, is an electro-magnet G^1. This magnet is formed of pairs of radial plates of soft iron, which stand out from the central axis, and are each wound around with insulated copper wire from end to end, as shown in the Fig., and in such a manner as to ensure that upon the passage of a current of electricity through the wire, their outer extremities will become alternately of north and south polarity, as indicated by the letters N and S (which mode of winding is well understood by electricians). The terminals of these wires are brought out through grooves or holes formed longitudinally through or upon the ends of the shaft G, which is kept from rotating with the drum C by means of the bridge piece H, to which it is secured by set screws or otherwise.

Outside the drum C, and in close proximity to it, are placed three electro-magnets I, I, I. These magnets are secured to the bridge B, B, of the main frame by the bolts and nuts *b b*, by which they can be adjusted, and they are so placed with respect to the radial plates of the magnet G^1 that their poles are opposed to the poles of the magnet G^1.

The magnets I, I, I, are wound with insulated wire in such a direction that upon the passage of the current their poles will be in opposition to the poles of the magnet G^1, as indicated by the letters N, S. The commutator F is formed of thin plates of metal placed radially around the hollow journal of the drum C, and insulated from each other and from the journal by vulcanite or other suitable material. The brushes for collecting the induced currents are carried by a ring K, secured to the main frame of the machine, but insulated from it; they do not possess any special feature above those ordinarily employed for such purposes.

EDISON'S ELECTRICAL GENERATOR.

By CHARLES A. SEELEY, PH.D.

ELECTRIC machines convert mechanical into electrical energy. The obtaining of electricity may be considered a manufacturing process, wherein steam power is the raw material and electricity the product. The best machine, other things being equal, will give the greatest yield of finished product from a given expenditure or consumption of raw material. The ratio of yield to consumption is the expression of the efficiency of the machine.

How many foot pounds of electricity can be got out of 100 foot pounds of mechanical energy? Certainly not more than 100; certainly less. What are the sources of loss, and what become of the lost foot pounds? Friction and resistance of the air inexorably demand their share in all kinds of machines. In the electric machine a heavy armature, sometimes spread out like a fanning mill, must be revolved at the rate of 500 or 1,000 times in a minute. Also, there are great leakages incidental and peculiar to the electric machine, which may be summed up in the expression local actions, which consist in currents induced outside of the normal circuit, changes in the magnetism of the magnet cores, &c. How many foot pounds do we lose, or are we obliged to lose, out of the 100 expended? How many foot pounds of electricity are left after deducting the losses? The facts and laws of physics, with the assistance of mathematical logic, never fail to furnish precious answers to such questions. People generally, however, are not familiar with the methods and language of exact science, and prefer results of direct, plain, actual, and practical experiments, results unmixed with any abstraction. We appeal now to the testimony of such experiments.

In 1877 a committee of the Franklin Institute, consisting of ten competent and eminent experts, with a view of determining the capabilities of electrical generators, made a series of trials with the best machines then procurable. Their elaborate report, describing the details of experiments, was published in the May and June Institute *Journal* of 1878. This report has become a recognised authority, and remains, so far as I know, in all respects unimpeached; and I shall use it now with fullest confidence in the accuracy of its statements. The committee experimented with six machines: three Brush, two Wallace, one Gramme. To suit my present purpose, I have reduced statements of the report to the simple symmetrical form of the table below. This table shows the losses and produce of 100 foot pounds of power delivered upon each machine; the figures may be read as representing foot pounds or per cents.

1	2	3	4	5	6
a. Brush	16·7	33·5	50·1	50·	31·
b. ,,	10·4	50·9	61·1	39·	22·
c. ,,	11·1	41·	52·1	47·	27·
d. Wallace	8·	53·2	58·2	38·1	14·
e. ,,	8·6	63·	71·6	30·3	12·
f. Gramme	7·4	21·	28·4	71·2	38·

1. Names of machines.
2. Friction and resistance of the air.
3. Local actions, including all losses, except those of 2.
4. Total losses, the sum of 2 and 3.
5. Total current of the normal circuit, or the total yield of electricity.
6. The electricity utilised in producing light. It is substantially the amount utilisable for any purpose.

I present this table as worthy of thoughtful attention; it should interest all electricians. The facts which a little study will disclose may prove somewhat appalling to those whose imaginations have been busy with bringing Niagara power to New York, and with the demolition of gas companies.

The facts shown in columns 5 and 6 are worthy of special attention. The total produce of electricity is shown in 5, and in 6 the practical value of that electricity; the figures in 6 are only about one-half the corresponding figures of 5. Why is it that when we have produced the electricity half of it must slip

away? Some persons will be content if they are told simply that it is a way which electricity has of behaving. But there is a satisfactory, rational explanation, which, I believe, can be made plain to persons of ordinary intelligence. It ought to be known to all those who are making or using machines. I am grieved to observe that many persons who talk and write glibly about electricity do not understand it; some even ignore or deny the fact to be explained. I will try to set forth the case plainly.

Electricity moves in a circuit, and in moving disappears; that is, it is converted into some other form of energy. The same electricity does not move round and round again; it never repasses the starting-point; it does not exist to repass the starting point. As it moves it falls and dies in its tracks, and its dead body at once and on the spot is resurrected, but in a changed form. Now a part of the circuit is always and of necessity inside of the machine or battery; it is the wire of the armature or the liquids and the metals of the battery. This part of the circuit also is inaccessible, and the electricity which is here transformed is unavailable; this electricity, in fact, is worse than useless, for the heat into which it is transformed is one of the serious practical difficulties of the machine. It is then only the electricity which appears in the circuit outside of the machine which is utilisable.

At this point plausibly comes in a suggestion that the internal part of the circuit be made very small and the external part very large. Why not (say) make the internal part 1 and the external 9, thus saving nine-tenths, and losing only one-tenth? Unfortunately the suggestion is not practical; a fallacy is concealed in it.

The electricity is truly converted throughout the entire circuit, but not evenly in proportion to the length of the circuit. The conversion takes place precisely and exactly in accord with the resistance in the circuit to the flow of the electricity. The electricity may be considered as distributed over the whole circuit *pari passu* with the resistance, and thereupon is transformed into energy of another name, distributed as to the quantity precisely as was the electricity. This explanation does not disclose the weakness of the suggestion, but it will assist us in finding it.

Beasts of burden and other rational creatures redouble their efforts when their burdens are increased, and "thrice is he armed," &c. Electricity behaves very differently; there are no moral suasions or reserved forces behind it. Increase its burden, and it weakens right down; it is more stubborn than a mule; it won't budge at all, except after its narrow plan. The law of the electric current is that it exists or is produced *inversely* as the resistance to its flow in the circuit; double the resistance and the current is halved; treble the resistance and the current is one-third, &c. In any machine let the armature revolve steadily, and the current produced will depend solely upon the resistance; with the least resistance you get the maximum current, with the greatest resistance you have the minimum current. Now, also, the internal resistance of any machine is constant or unalterable. In order to get any external effect, external resistance must be added to the internal. To get the greatest yield from a machine or battery, it must be short-circuited; that is, the external resistance must be suppressed; but then you find yourself in the interesting predicament that all the electricity is securely bottled up in the armature, and is of no good to you. On the other hand, arrange things so that the greatest part of the resistance is external, and the electricity has shrivelled up to a quantity which is utterly useless to any allopath. There is evidently a just mean; what is it? What is the best practical ratio of the external and internal resistance? The mathematical calculations which clearly and beautifully answer this question, and which take in the principle that the sum of variables is least when they are equal, are probably beyond the experience of the average reader, and I substitute a sort of cut and dry method.

Let the current of the short circuited machine be (say) 100. Now add an external resistance (R″) equal to the internal (r), thereby making a doubled total resistance (R). ($r + R' = R$). The total current has become 50, and the external or utilisable part of it is 25. Treble the R, making $r = 1$ and $R' = 2$, and the total current becomes 33⅓ and the utilisable part 22·2. For another trial, make external half as great as internal $r = 1$, and $R' = \frac{1}{2}$, and total current becomes 66·6, of which 22·2 is utilisable. Now we are getting indications of the fact that the greatest external current is produced *in a given time* when the external and internal resistances are equal. I recommend the reader who is not yet satisfied to continue the cut and dry plan till he shall be.

But, exclaims the bright scholar who is always on the *qui vive* for flaws, it is a question of economy, and it may be best to take a little more than the given time, and so get a greater portion than the half for our use; time is cheaper than coal; or, if we must have a certain great quantity of electricity in a short time, we may build a very big machine or use a good many little ones; why not save nine-tenths of the total current? The remarks of the bright scholar are always entertaining, sometimes they are instructive. The trouble with him is that, although his vision is very clear, it is not so wide; he is quick to spy out a thing, but he does not observe its environments. Why not nine-tenths? It is a hard thing to do after perusing the table of results above given; but consider or imagine that the losses of a machine by friction and local action are reduced to one-tenth, so that 100 foot pounds of steam-power produce 90 foot pounds of current, of which the external part of the circuit (= to the internal) shall have 45. Now adjust external resistance so that you shall get nine-tenths outside and one-tenth inside, and weigh and figure up the results. Instead of getting 9 for 10 invested, you have 16·2 avails of 28 invested, or at the rate of 5·8 from 10 invested. There is a clear gain by attending to the spigot, but the steady leakage at the bung was still going on. I do not mean to say that the equalising r and R′ should be an inflexible practical rule, but simply that the advantages of varying from it are not so great as some persons suppose; also the loss from local action is not constant for varying products of electricity; the illustration ought not to mislead any one, and the precise data for determining the peculiar ratio of r to R′ for the most economical working are plainly enough indicated.—*Scientific American.*

DR. AGER'S TELEGRAM CODE.

SOME few weeks ago a favourable notice, we believe from the pen of Sir James Anderson, was given in a contemporary of the above code, which was then about passing through the press. Since that time, in the same journal, a letter has appeared from the worthy secretary of the Eastern Telegraph Company, and also a paragraph respecting the same subject. Dr. Ager has replied by a circular letter, a copy of which has been handed to us, and, in justice to the Doctor, we append the principal portions thereof. The code, we hear, is selling well, and we congratulate Dr. Ager on the fact, for if hard work and the use of great ability and intelligence in the attainment of an object deserve success, then does that gentleman well merit all he obtains.

DEAR SIR,—The extraordinary action of the Eastern Telegraph Company in publishing a circular respecting *The Standard Telegram Code* renders it incumbent upon me to issue a reply, in order to correct some of the misstatements contained in that circular.

My counter-statement is a simple one—simple as truth usually is—and I venture to think that every act of the Eastern Telegraph Company, down to their last, may be adduced in support of my statement.

Late in July last I received an invitation to meet Sir James Anderson, who had, I was informed, decided upon the joint publication by the Telegraph Companies of an authorised code, to be compiled by me.

In response to this invitation, I met Sir James Anderson, and stated to him the terms upon which I would engage to compile a code of 100,000 words, to be chosen from 170,000, which I had been collecting during the last three or four years. Sir James Anderson thought my terms too high, but he, nevertheless, advised me to proceed with the compilation. About a month or six weeks later, *i.e.*, after Sir James had taken his holiday, I received a second invitation to call upon him.

At this interview it was definitely arranged that I should publish the work, under the patronage of the Eastern Telegraph Company, and I promised to submit to Sir James Anderson, from time to time, proofs of the code (I use his exact words), "In order that I may be able to say that I have seen it during its compilation."

The matter was fully—very fully—discussed by us. I informed Sir James Anderson that over 25,000 of the 100,000 words were in print. Moreover, I informed him as to who was printing the work, and he reproached me for not having given it to a printer whom he named.

No single word was uttered about my submitting the proofs to the telegraphic companies for the purpose of revision, or I should have found it necessary to mention a former experience when a telegraph official undertook to revise my code words, and passed a considerable number of duplicate words.

As 25,000 words were in type at the time this agreement was made, any supervision of the work would necessarily have been but partial, and I venture to ask candid logicians to compare my statement and that lately put forward by the Eastern Telegraph Company, with the notice of the work sent through Sir James Anderson, and published on October 11th.

I lost no time in submitting to the Eastern Telegraph Company a series of proofs that chanced to be then in hand.

Of the description of these given in the Eastern Telegraph Company's circular, I have, I think, most right to complain. They remark "That these were much objected to."

Coming from a telegraph company, these words may well be supposed to convey the indictment that the code words I submitted were unsuitable for telegraph purposes; whereas the the only substantiated objection to them was their *length*. (In truth, as these words commenced with "Col," "Com," "Con," they were, as every linguist knows almost all such words to be, somewhat long.) Moreover, the fact is suppressed that the words in this selection *were commended for their liquid character*.

The first proofs sent were returned to me after about a month or five weeks, when I sent, as per agreement, another set. These I have not yet received, and have therefore not sent any more.

To have made the completion of this work dependent upon the action of the Eastern Telegraph Company would, according to their own statement of the agreement between us, have delayed the publication of *The Standard Telegram Code* until very near the time appointed for the next conference (1884).

My position, for a long time a mystery to me, is now well defined—I am no worse off than other code makers; and, knowing as I do the qualifications of my staff and their zeal to secure accuracy, I feel inclined to consider myself better off than others. I have collected 100,000 genuine words so liquid in character as greatly to reduce the chances of mutilation, and with such a fair alternation of long and short words as will render detection easier when errors occur; and as I have had many proofs of Sir James Anderson's anxiety to facilitate telegraphic communication, I am not without a hope that the Eastern Telegraph Company will return to the agreement as at first made between us; but should I be disappointed in this, I appeal to the mercantile world to do me the justice denied me in other quarters. The words have been compiled in *strict accordance with the London Convention Rules*, and I have in my preface renewed the promise to exercise a continued vigilance as to the elimination of unsuitable words, and to provide an easy and efficient method of correcting such as I may hereafter discover or those that may be pointed out to me.

The book is now published and ready for delivery.

I am, dear Sir, very faithfully yours,

GEO. AGER.

50, Wellington Road, Stoke Newington, N.
Nov. 25, 1879.

Notes.

PNEUMATIC TELEGRAPHS IN PARIS.—A portion of the pneumatic telegraph system, which is intended to supersede the electric, as far as the local system in Paris is concerned, is now in working order. The "carriers," which contain the messages, and which are driven through tubes by pneumatic pressure, are of leather, and contain a number of tin boxes in which the messages are packed. Each box takes 30 message forms, and 12 to 15 of the boxes are placed in a row in the "carrier." Every box is marked with a letter indicating its destination. Several receiving offices are at intermediate places on the route of the tubes, and from these offices as the boxes containing the messages are received, the messages are despatched to their destination by messengers. A disadvantage of the pneumatic system in place of an electric exists in the fact that the number

of despatching and receiving offices must necessarily be limited, as, if a number of small offices, such as exist in London, were served by a pneumatic system, the expense of the plant would be enormous. In London, a pneumatic system, as a supplement to the electric, is found to be of great value, and is extensively employed.

STATUE OF GALVANI.—On Sunday, November 9th, a statue of Galvani, in the act of touching with two different metals the lumbar nerves of a frog, was dedicated at Bologna, his native city.

THE BELL AND EDISON TELEPHONES.—The Edison Telephone Company are bringing an action against the Bell Telephone Company for infringement of patent; the action has reference to the Blake transmitter, of which a description was published in the number of this Journal for October 1st, 1879.

CABLE REPAIRING.—In the repair of the Bilbao-Lizard cable by the Silvertown Telegraph Works Company, which was effected recently, an instance was afforded of the extraordinary accuracy with which the locality of a fault can be detected by testing. The repairing ship having grappled the cable at the point indicated by the test, and raised it to the surface, the fault was found to be only *fourteen fathoms* off from the point where the grapnel had hooked the cable.

SIGNALLING BY ILLUMINATED STEAM.—A novel method of signalling was recently tried at Blackwall by the Trinity Brethren. The apparatus is the invention of Mr. Carl O. Ramstedt, and consists of a dished chamber, in which is burnt coloured fire. The flare produced is reflected by means of a reflector on escaping steam, which it illuminates; by flashing the light on the steam in flashes of long and short duration the usual signals can be transmitted. It is stated that the illuminated steam can be seen at a considerable distance.

THE TELEPHONE IN MINES.—A trial has been made of Edison's telephone in the Wheal Uly Mine, Cornwall. One instrument was placed in the account house and the other at the adit level, 26 fathoms below the surface of the ground. The trial was satisfactory, as conversation could be carried on, in spite of the noise made by the stamps near the account house, and the splashing of water in the adit.

THE ELECTRIC LIGHT is being introduced into several of the Lake Superior iron mines.

THE TELEGRAPH IN JAVA AND SUMATRA.—The Dutch have established telegraph lines in their possessions in Java and Sumatra. The construction of these lines has been very difficult, in consequence of the wildness of the country through which they pass. Elephants, tigers, bears, and buffaloes were a source of continual danger to the inspectors and linemen who patrolled the lines. Monkeys, both large and small, seemed to consider that the lines were specially erected for their gymnastic exercises, and they continually broke the wires by hanging to them in great numbers.

THE NEW FRENCH ATLANTIC CABLE.—The cable of La Compagnie Française du Télégraphe de Paris à New York was formally inaugurated on the 20th ult. by President Grévy sending a telegram to President Hayes, expressing the most cordial sentiments towards the President of the United States. Mr. Cornell Jewett's threatened opposition to the landing of the cable has come, as we anticipated it would, to naught, and the company having previously placed extensive orders in this country for telegraph wires, have rapidly connected the shore end with New York. The *Faraday* will lay the Cable between St. Pierre and Torbay before returning, and afterwards it will probably be considered desirable to again despatch her to connect, by a branch cable, Brest with the G.P.O. wires at the Land's End.

MAGPIES AND THE TELEGRAPH.—A curious cause of interruption, says the *Journal of the Melbourne Telegraph Electrical Society*, occurred lately on two of the Western lines, Australia. An intermittent "cross," one of the most troublesome of faults to detect, existed for some little time on these lines, and a close inspection was found to be necessary. This resulted in the discovery that some magpies (Australian) had actually built a nest on one of the telegraph poles, and, among other materials used in its construction, had taken all the odd pieces of tie-wire which they could find within some distance of the spot: scraps which had been thrown aside by the line-repairers were twisted up together in the most singular manner, considering that they had no "plyers" to work with excepting their beaks. Some of these pieces of wire touched one line and some occasionally the other, causing the "cross" complained of. It appears that lately several attempts at nest-building on the part of magpies have taken place on telegraph poles on the plains in the Western District.

AN OBSERVATORY ON MOUNT ÆTNA.—It is intended shortly to erect on Mount Ætna an observatory for meteorological, astronomical and seismological purposes; it will be 9,652 feet above the sea-level, and will be the second highest observatory in the world. The purity of the atmosphere is so great at the place that the naked eye acquires a power of vision which can be exercised elsewhere by means of a small telescope, whilst the planet Venus casts a perceptible shadow.

THE papers of the late Professor Clark Maxwell will be arranged and published by Professor Stokes, who is one of the executors.

A NEW THERMOMETER.—M. Debsun has lately brought before the French Academy an electric-capillary thermometer; the instrument is formed of an ordinary fine thermometer tube filled with acidulated water; a chain of drops of mercury are also placed in the tube, the first and last drops being connected with platinum wires at the ends of the tube. When the acidulated water is dilated by increase of temperature the globules of mercury are changed in shape, this causes a current of electricity to flow, the strength of which current is proportional to the dilation of the acidulated water. The current so generated may be observed on a Lippman electrometer; the apparatus is said to be very sensitive.

A COMPACT form of Gramme machine has been constructed for Professor Stefsan, of Vienna, by M. Niaudet. In this apparatus the permanent steel magnets are of a circular form, and the cheeks, which embrace the revolving armature, are of a novel shape.

THE RONALD'S LIBRARY.—The binding of the books which form this library is now being proceeded with, under the supervision of Mr. A. J. Frost. It may be remembered that the conditions under which the library was to be held by the Society of Telegraph Engineers were that the books were to be bound at the society's

expense. The surplus of the fund for entertaining the members of the Telegraph Conference, as we announced in our last number, having enabled this to be done, it is satisfactory to know that the work is progressing, and that the library will be secured to the society.

THE medals awarded and recommended by the Council of the Royal Society for the present year are:—The Copley Medal to Professor Rudolph J. E. Clamins, of Rome, for his researches upon heat; the Davey Medal to M. P. E. Lecoq de Boisbandran, for his discovery of gallium; a Royal Medal to Mr. William Henry Perkins, F.R.S., for his long-continued and successful labours in geology and physical geography.

THE phenomena of evaporation and distillation, under the influence of electrification, has lately been studied by M. Gernez. The liquid under test is placed in an inverted U-shaped tube, so that liquid is present in either limb and at the same level. Sparks from a Holtz machine are passed across the bend, which is clear of liquid, and it is found that this causes the liquid to distil, as it were, over into the other. Pure alcohol distils over three times as fast as water, but a mixture of the two at a less rate than the latter. The addition of a soluble salt increases the rate of distillation. Some liquids, such as bi-sulphide of carbon, or turpentine, do not exhibit the phenomena.

TELEGRAPHIC communication with Cabul was completed on the 21st ult.

THE ELECTRIC LIGHT AT THE BRITISH MUSEUM.—For more than a century readers at the British Museum have been obliged to suspend their labours on occasions when the vagaries of our temperate climate have been more than usually wild. On Saturday morning, shortly after 10 o'clock, many readers, following previous traditions, were about to cease their labours on account of the impossibility of making their eyes and the figures on the books meet, the dense fog which reigned having completely got the mastery. Messrs. Siemens, however, were quite equal to the occasion, and quite unexpectedly the spacious room was illuminated as by magic, to the great satisfaction of all present. Several improvements have taken place in the apparatus since it was first put in action for the Museum. The reflectors of the lamps, at the suggestion of Mr. Bond, the principal librarian, have been gilt instead of silvered, thus taking off somewhat from the coldness of the light, and making it more like sun than moonlight. There can be no doubt about the perfect success of the illumination.

M. J. VIOLLE, in "Comptes Rendus," says: "The specific heat of iridium, like that of platinum, increases regularly with the temperature. The mean specific heat varies little up to 600°, and then increases sensibly on approaching the melting point." The melting points given are:—Silver, 954°; gold, 1,035°; copper, 1,054°; palladium, 1,500°; platinum, 1,775°; iridium, 1,950°.

THE American *Operator* says: "The Western Union has been very unfortunate in its law-suits lately. In addition to the Colgate and the telephone cases, every suit it brought against the American Union has been decided in favour of the latter company, while the only case brought by the American Union against it—a motion for an injunction in the New York Central matter—has been granted."

MR. HENRY W. POPE has resigned his position of General Superintendent of the American District Telegraph Company, and accepted a similar one with the National Bell Telephone Company, New York.

THE Bell Telephone Company, of America, and the American Speaking Telephone Company have, after much litigation and considerable negotiation, at last amicably arranged their little difficulty. As the agreement, which is very voluminous, was not signed when the mail left, the contents could not be ascertained.

WE hear that the Edison Telephone Company are launching exchanges in Cornhill, in Eastcheap, in Westminster, in Chancery Lane, and in St. James's.

MR. EDISON has announced by telegram that he has modified his telephone, by substituting for the manual turning of the chalk cylinder an automatic apparatus which, having been wound up, will supply the necessary friction, and thus leave the operator free to write from dictation, to take shorthand notes, or *to set up type*. (?)

IMPROVED TELEGRAPH WIRE.—To produce telegraph or other wire of high and uniform quality, of high electrical conductivity, and capable of withstanding a high tensional and torsional strain, Mr. Cooke, of Rotherham, has patented an invention which consists in reducing the quantity of carbon, silicon, sulphur, and maganese existing in common metal, to the relative proportions in which they exist in best iron. He first produces, by ordinary means, and in ordinary apparatus, a metal containing:—Iron, 99·753; carbon, 0·450; silicon, 0·077; sulphur, 0·070; and manganese, 0·890. This metal, or metallic alloy, he cuts into small pieces and places in a furnace, and surrounds it with charcoal, and subjects it to one or more currents of atmospheric air, by which means it is melted, the action of the air and charcoal upon the metal, or metallic alloy, being continued until the elements in excess are reduced to the proper proportions to ensure the iron being of the quality specified. The mass of fused iron is balled up, and forged and manipulated in the ordinary way.

MR. L. SCHWENDLER, in a paper published in the *Journal* of the Asiatic Society of Bengal, says: "It appears that light by *incandescence* is scarcely any cheaper than light by *combustion*. The reason of this is that the temperature of an incandescent platinum wire is not very much higher than the temperature of a flame, and that for unit volume the mass, which has to be kept heated in a piece of platinum, is much larger than the mass in a flame. Unless we should be fortunate enough to discover a conductor of electricity with a much higher melting-point than platinum, and the specific weight and specific heat of which conductor is also much lower than for platinum, and which, at the same time, does not combine at high temperatures with oxygen, we can scarcely expect that the principle of incandescence will be made use of for practical illumination."

CAPACITY OF VOLTAIC POLARISATION.—M. R. Blondot has measured the amount of electricity required to polarise the electrodes of a voltameter using a current of feeble electro-motive force. When the electro-motive force is low, there is an approximate relation between the charge and the electo-motive force of polarisation; when it is high, the charge increases more rapidly than the polarisation. For a given electrode and electrolyte the initial capacity does not depend on the kind of polarisation.

SEVERAL kinds of plants, according to Naudin, seem to flourish better if protected from the action of atmospheric electricity.

SPECIFIC MAGNETISM OF IRON forms the subject of an essay by Dr. Auerbach, of Breslau. He shows that this is not without influence on the galvanic behaviour of the metal. If a current be conducted through an iron wire, phenomena appear which do not occur with other metals. The following are some of the known facts:—The actual galvanic conductivity has been variously stated between 12·35 and 15·9 per cent. Resistance increases with rise of temperature. The heat generated, by Joule's law, is 448·0, as against 478·9 for copper. On closing the circuit, an extra current takes place in the opposite direction; on opening, in the same direction. Longitudinal magnetisation of iron influences its resistance. In examining the last phenomenon, the great difficulty was to exclude the influence of temperature. An adiathermanous magnetising apparatus was made by winding the wire on a glass tube, into which a caoutchouc tube was introduced, with a smaller glass tube within it, the wire itself being wrapped in paper. Special arrangements were made also to reduce the intensity of the extra current. These due precautions having been observed, a large transient and a smaller permanent diminution of resistance was observed, the former amounting to 2 per cent.

CLAMOND'S THERMOPILE.—The pattern now in use for lighting a workshop in Paris is 2½ metres high, and one metre in diameter. Another model, made for exhibition at the Albert Hall, is square and smaller, though of the same power. Each half of the cylindrical battery can be made to supply a powerful electric light, while the square one can produce four lights of half the brilliancy. The E. M. F. is, according to prolonged experiments, 218 volts, about equal to 120 Bunsen cells, while the resistance is only 31 ohms. The large battery consumes 9 or 10 kilogrammes of coke per hour; the smaller about 6½ kilogrammes. The large external surface of the apparatus, radiating its heat to the air around, fits it for warming purposes as well as for lighting.

THE TEMPERATURE OF CARBONS GIVING THE ELECTRIC LIGHT has been examined by M. Rosetti, by means of a thermopile, the face of which is placed at a suitable distance to receive rays from a radiating surface of determinate size; the thermal effect being measured by a sensitive reflecting galvanometer. He comes to the conclusions that (1) The positive pole has higher temperature than the negative. (2) The temperatures vary according to the intensity of the current. (3) They are higher the smaller the radiating surface, provided it comprises the extreme point. (4) In the negative pole, the minimum temperature was 1910° Cent., with a large radiating surface of small brilliancy; the maximum 2532° Cent., the radiating surface being half the preceding. (5) For the positive pole, the minimum temperature was 2312°, the carbon being large; the maximum 3200°, with a thin carbon and small radiating surface.

FROM experiments made by Dr. Carl Barus, he concludes that the thermo-electric position of steel progresses continuously with its degree of hardness, or, in other words, thermo-electric and mechanical hardness are functions one of another. Also that the specific resistance of steel increases continuously with its mechanical hardness.

THE TELEPHONE COMPANY.—The Telephone Company's Exchange is progressing; nearly 150 subscribers now have their places of business connected with the Exchange stations, which are three in number. The annual subscription for subscribers within a radius of a mile from the Exchange stations is £20 per annum.

THE "Edison Telephone Company" have opened offices at Royal Exchange Square, Glasgow; and the "Telephone Company" at 72, Queen Street, in the same town.

THE telegrams sent from the City (exclusive of the Stock Exchange) during the month of October last, as compared with October, 1878, have increased from 182,964 to 234,839, being an increase of 51,875, or about 28 per cent. From the Stock Exchange, the increase over the month of October in last year has been from 79,370 to 112,163, being an increase of 32,793, or about 41 per cent.

IN a series of experiments recently described to the Vienna Academy, Professor von Waltenhofen has sought to deduce the mechanical equivalent of heat by a direct measurement of the work done by an induced electric current in a closed circuit of given resistance. For this purpose, a magneto-electric machine was used, whose electro-motive force was ascertained to be proportional to the number of revolutions. The magneto machine was furnished with an arrangement for producing an indicator diagram showing the work done. The induced currents were measured by means of a tangent galvanometer. The results were found to be in satisfactory agreement with Joule's equivalent.

PROGRESS OF THE ELECTRIC LIGHT.—The Société Générale de l'Electricité has arranged with Messrs. Samuel Brothers, of Ludgate Hill, to light their warerooms with twelve Jablochkoff lights, and the counting-house with one, the whole to be driven from a 12-horse-power Otto gas engine. At the Creusot Iron Works, M. Schneider has contracted for the Jablochkoff light to be applied in the draughtsmen's office, and also to the fitting-shop. The Antwerp Basin was lit on the 14th ult. by the company. Following the example of their *confrères* of Antwerp, the municipality of Havre have extended the number of lights used by them from 12 to 52, and have contracted with the Société for ten years.

THE BALEARIC ISLANDS CABLE.—The submarine cable between Ivica and Majorca has been successfully completed, and the tests of it are perfect. This cable was manufactured for the Spanish Government by Mr. W. T. Henley, of North Woolwich, and sent out during the summer, but in consequence of the depth of water (500 fathoms) being twice as great as marked on the charts, and also owing to the cable being a very heavy one, so much slack had to be paid out that there was not sufficient to reach the landing-place by many miles. In this dilemma, Mr. Henley directed that the cable should be taken up again, which was done, and it was brought back to England, overhauled, and lengthened, and it has now been relaid with the expenditure of only one mile more cable than was first sent out.

MARCH *v.* TWEEDDALE, AND MACKINTOSH *v.* ANDERSON.—These actions were brought against Sir James Anderson, the Marquis of Tweeddale, Mr. George Cavendish-Bentinck, M.P., Lord A. Paget, Mr. P. Rawson, and Mr. C. E. Lewis, M.P., the object being to obtain a declaration that the holders of the preference and deferred certificates in an investment trust-fund were entitled to rank equally. In 1872 the defendants issued a prospectus inviting subscriptions for a share

investment trust. They proposed to raise a capital of not less than £500,000 or more than £2,000,000 by £100 shares, each subscriber to receive £100 Six per Cent. Preference Certificates, redeemable from an accumulated sinking-fund of 1 per cent., by yearly drawings, at the price of 10 per cent., and also a £100 Deferred Certificate, which should entitle the holder to the surplus and ultimately to share in the trust-fund. The object in raising the money was to use it in prosecuting great industrial undertakings, such as submarine cables, tramways, iron and engineering works, and so on. A recent decision, however, ruled the investment company to be formed in contravention to the Lotteries Act. Mr. Davey, Q.C., Mr. Chitty, Q.C., Mr. Ince, Q.C., Mr. Romer, Mr. Alexander Young, and Mr. M'Laren appeared as council in the case. After some discussion, his lordship, with the consent of all parties, gave the same decision as in the case of "Lewis *v.* Cecil," which he decided last term, and ordered that the secretary should be confirmed in his office, for the purpose of winding-up the trust.

WE are glad to find that Colonel Reynolds has returned safe to England, and is looking well.

THE cable between Jamaica and Colon is repaired, and the cable between Antigua and Guadeloupe interrupted; as the St. Croix Trinidad cable is not yet repaired, there is at present no communication with Guadeloupe, Dominica, Martinique, St. Lucia, St. Vincent, Barbadoes, Grenada, Trinidad, Demerara, or Berbice.

Proceedings of Societies.

PHYSICAL SOCIETY.

AN Ordinary General Meeting of this Society was held on Nov. 22nd., Professor W. G. ADAMS in the chair. The following new members were proposed and elected:—Professor Reilly and Professor Heath, of Cooper's Hill Engineering College. Professor GUTHRIE then exhibited a new photometer in its crude form, and demonstrated its action to the meeting. It consists of two fixed plane mirrors, inclined to each other at an angle. The rays from the two sources of light to be compared are allowed to fall on these mirrors; those from one source, say that on the right-hand, falling on the right-hand mirror, and those from the left-hand source on the left-hand mirror. These rays are again reflected from the mirrors at right angles to their former paths and thrown upon a semi-transparent screen, where their relative densities can be compared by the eye of the observer. Between the mirror and each source of light a revolving shutter is interposed. These shutters are formed of brass discs, and they are both mounted on the same axis, which can be turned by the hand or otherwise. They would completely screen the light from the mirrors were it not that each is provided with four radial apertures, or slots, through which the rays can pass. The slots on the side, at which the bright source of light is placed, are narrower than those on which the weaker source is placed. The latter slots are made adjustable in size by sliding blinds, and a scale is added to measure the degree to which they are closed. On revolving the shutter the reflection of the rays to be compared, are seen side by side, and (owing to the persistence of images on the retina) continuously on the screen placed in front; and they are brought to equality of brightness by closing or opening the blinds of the adjustible shutter. When this is so, the rates of the respective orifices of the shutter, as given by the scale, is the ratio of the luminous intensities compared.

Professor ADAMS remarked that the speed of rotation should be such as to produce a uniform field of light on the screen, a result which hand-turning was not very conducive to.

Professor FOSTER, too, observed that the use of this new photometer might be less fatiguing to the eye than those photometers which presented a steady beam to the eye, undiluted with intervals of darkness, during which the light is cut off, as in the instrument before the meeting.

Professor REINHOLD then read a paper, by Professor RUCKER, of the Yorkshire College, Leeds, on "A Suggestion as to the Constitution of Chlorodine offered by the Dynamical theory of Gases." If a gas of density 8 consists of molecules, each of which posseses m degree of freedom, and if, also, the intermolecular forces are negligable, the specific heats at constant pressure ($c\,p$) and at constant volume ($c\,v$) are connected by the well-known equations:—

$$10\,(c\,p - c\,v)\,8 = \cdot 0694$$

$$20\,\frac{c\,p}{c\,v} = 1 + \frac{2}{m+e}$$

Where e is a quantity which depends upon the potential energy of a molecule. Hence, if $c\,p$ is given by experiment, $c\,v$ can be calculated from the first equation, and then m and e are known from the second. Regnault determined the specific heats at constant pressure of 35 gases; and from the experiments of E. Weidemann and of Wullner, it appears that his values are correct within 6%, and that m and e can be calculated very closely from the above equations if $c\,p$ is given. One of the chief difficulties of the thermo-dynamic theory of gases has been to attribute to m and e values which would at once lead to the observed ratios of $c\,p$ and $c\,v$, and satisfy any rational supposition as to the interior mechanism of a molecule. Kundt and Warhng proved that for mercury $\frac{c\,p}{c\,v} = 1{\cdot}666$, which is consistent only with the supposition that the atoms o mercury are smooth, rigid spheres; and Boltzman and Bosanquet have pointed out that for a smooth, rigid surface of revolution $\frac{c\,p}{c\,v} = 1{\cdot}4$, a number agreeing closely with the experimental values for AW, O, N, H, C O and N O. The molecules of these gases may, therefore, be constituted of two spheres rigidly united, or as Mr. Rücker suggests, bound together by forces which prevent the separation of their surfaces while leaving them otherwise free to move. The principal object of Professor Rücker's paper was to point out an interesting fact connected with the application of this theory to chlorine. The maximum number of degrees of freedom which a molecule, composed of N smooth, rigid spheres, could possess, would be $3n$, but the forces in play between the spheres might reduce this number. Thus the value of $m + e$ could not exceed, but might be less than $3n + e$ when the molecule consists of two atoms, $e = o$, but for complex cr molecules, rc should—*caeteris paribus*—expect its value to increase with the number of molecules. From two tables of results calculated by him, Professor Rücker, however, finds that for a number of simple and complex gases and vapours the value of $m + e$ is for each substance less than $3n$ (or the maximum possible value of m); while for the majority of chlorine compounds examined, the reverse statement holds good, that is, the value of $m + e$ is generally greater than $3n$. This difference may be explained by supposing that for chlorine e is abnormally large; that the spheres are not necessarily

in contact; or that n has been taken too small; that the symbol Cl_3 is incorrect, and that the chlorine atom contains a larger number of sub-atoms than has been supposed, a supposition which accords with the recent researches of Professor Victor Meyer on the vapour density of chlorine. Professor Rücker also finds that the ratio of the specific heats of bromine and one of its compounds studied ($C_2 H_2 Br$), agree with those of chlorine and the corresponding chlorine compounds.

Dr. SHETTLE, of Reading, then read a paper on the "Influence of Heat upon Certain Forms of Induction Coils, considered more especially in relation to the Inductive Power which the Blood exercises on the various Structures of the Body." The author found that when a copper and a zinc wire were insulated from each other by parchment paper and paraffined silk, and wound in close proximity to each other, an (induced) current was indicated on a galvanometer whose terminals were connected to the neighbouring ends of the zinc and copper wires respectively; the other ends being left free. When the latter were connected across, the deflection was *nil*. On raising the temperature of the two wires by causing hot water to flow inside the coil, into which they were wound, the deflection was largely increased. These experiments led Dr. Shettle to imagine that there is a similar action in the animal body. The heart is made up of nerves and muscular fibres, winding spirally, and some of these wind round each other so as to form a spiral cord, round which the blood capillaries also wind. Dr. Shettle compares these nerve and muscle bundles to the coils of zinc and copper wire in his experiments, and infers that electric currents may be induced in them as in the wires. The flow of the warm magnetic blood would also tend to produce currents in them. Dr. Shettle further drew attention to the fact that animals live and move in a magnetic field, and that electricity must be generated in them by their movements, internal and external.

Mr. EMMOTT exhibited Crossley's form of microphone, which consists of four short rods of carbon, jointed loosely with four blocks of carbon, so as to form a square. It is used as a transmitter for telephones; and Mr. Crossley regularly transmits the services of a church with it to several hearers. Its speaking, singing, and whistling powers were successfully demonstrated to the meeting.

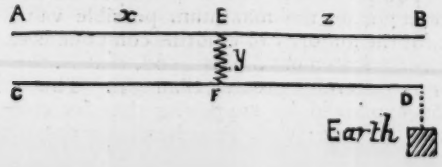
THE SOCIETY OF TELEGRAPH ENGINEERS.

AT the ordinary general meeting of this society, held Nov. 26th, Major BATEMAN-CHAMPAIN, R.E. (President), in the chair, the minutes of the last meeting having been read and confirmed, a paper by Mr. FELIX GAREY (foreign member) on "Condensers" was read. The paper being of a purely theoretical character, is not of sufficient interest to warrant a report being given here.

At the conclusion of the paper,

Professor HUGHES rose and expressed his surprise that a paper of such a purely theoretical character should have been brought before the meeting; he considered that it was only suited for publication in the proceedings of the society.

A paper by M. FEDELE CARDARELLI (foreign member) on "A Method of Localising a Contact between Two Telegraph Wires," was then read. The method is as follows:—



If A B, C D are the two wires which are in contact at the point y, then the end B of the wire A B is kept insulated, and the end C of the wire C D is also kept insulated, whilst the end D is put to earth. A resistance measurement R is then made from A, which gives the result,

$$R = x + y + z.$$

The end C is then joined to A, and a new measurement made: then the new resistance r is

$$r = z + \frac{(x+y)\,x}{x+y+x};$$

also if L be the resistance of the line, then

$$L = x + z,$$

by combining the three equations the result is obtained

$$x = L - r + \sqrt{(R-r)\,(L-r)}.$$

In the discussion which followed the reading of the paper,

Mr. KEMPE pointed out that the formula obtained was exactly the same as that for Blavier's well-known method of localising the position of an earth in a line.

New Patents—1879.

4405. "Electric lamps." A. V. NEWTON. (Communicated by F. Tommasi.) Dated October 29.

4549. "Insulated electric conductors." J. BELL. Dated November 8.

4555. "Improvements in and appertaining to electro-magnets." J. BELL. Dated November 8.

4572. "Conductors or cables for telephonic apparatus." W. R. LAKE. (Communicated by E. Holmes and E. T. Greenfeld.) Dated November 10.

4573. "Electric telegraph apparatus." C. D. ABEL. (Communicated by E. George.) Dated November 10.

4576. "Improvements in electric lamps, and in the method of manufacturing the same." T. A. EDISON. Dated Nov. 10.

4589. "Improvements in apparatus for generating electric currents, also in electric lamps, and in the manufacture of carbons to be used therewith, part of which improvements is applicable to electro-magnets generally." C. F. HEINRICHS. Dated November 11.

4590. "Apparatus and mechanism for electric lighting." G. P. HARDING. Dated November 11.

4593. "Electric signal or indicator apparatus." W. MOSELEY. Dated November 11.

4613. "A needle sounder." F. M. ROGERS. Dated November 13.

4653. "Improvements in the transmission of power by electricity, and in the apparatus employed therein." J. HOPKINSON. Dated November 14.

4696. "Electro-magnetic engines." A. M. CLARK. (Communicated by J. S. Laman.) Dated Nov. 18.

4708. "Improvements in, and connected with, electric bells; specially designed for signalling from the rooms of passenger ships and hotels, and for other purposes." J. WHITE. Dated November 19.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1879.

1307. "Iron telegraph posts." FRANK WIRTH. Dated April 2. 2d. The post consists of a central bar of rolled iron, preferably about five metres long and thirty millimetres thick, and three rods of round rolled iron, preferably four metres long and thirteen millimetres thick. These rods are provided at the top with heads,

and with slots, or recesses, into which the said rods are passed, and with projections on its upper surface, behind which the heads on the said rods rest when they ar placed in the said recesses.

1374. "Electric direction and pressure wind vanes." DAMPIER SEABROOK VERNON. Dated April 7. 2d. The apparatus consists of three parts, viz., the vane, the indicator, and the battery; and the object of it is to dispense with shafting.

1383. "Electric telegraph apparatus for transmitting orders on shipboard, &c." JAMES PITKIN. Dated April 7. 2d. This invention relates to an improved electric telegraph of exceedingly simple construction, for use on board ship, for transmitting orders from the bridge to the engine-room or helm. It consists of a dial bearing the usual words of command, a disc of insulated material placed beneath, carrying a circle of metallic contact pieces at uniform distances, a part connected to a central plate, and a pair of contact springs, insulated and placed diametrically opposite one another in the parts of the contact pieces on the disc, and connected respectively to the two portions of the battery circuit in which the instrument is placed. The disc is rotated by a handle working over the dial, and at each passage of an opposite pair of contact pieces, or of the alternate spaces over the contact springs, the circuit is completed or broken, the completion of the circuit corresponding with the passage of the handle from one division of the dial to another. The indicator comprises a similar dial, with a pointer having an escapement wheel on its axis, actuated by a pallet on an arm or extension, carried by the armature of an electro-magnet in the circuit.

1387. "Dynamo and magneto-electric machines for lighting, plating, &c." ARTHUR WELLESLEY LAKE. Dated April 8. 4d. The object of this invention is to simplify and cheapen the construction of dynamo and magneto-electric machines, increase their electrical capacity or working power, lessen the cost of the mechanical or driving power employed for rotating the machine, and make the electric currents more nearly continuous. It consists of improved forms of the armature enclosed by and between the pole faces of the electro-magnets of magneto and dynamo-electric machines. Secondly, improved forms of armature cores. Thirdly, a rotary automatic "circuit maker and breaker." Fourthly, combining a rotary circuit maker and breaker, with an outer or external circuit or "shunt," so arranged as to direct or draw out of the main circuit the opposing currents, and by this means neutralise their evil effect. Improvements in lamps are also included.

1476. "Telephones, &c." H. J. HADDAN. Dated April 16. 6d. (Communicated by Abner Mulholland Roseburgh, of Toronto.) Relates more particularly to the combination of a telephone and signalling apparatus in one instrument, and consists in directly or indirectly making use of a single or compound magnet in common, both for the telephone and for the signalling apparatus. Secondly, in a method of generating different qualities of electric currents so as to be able to affect either an armature or a diaphragm of a distant instrument or instruments. Thirdly, in a method of constructing a magneto-electric signalling apparatus so that it may be inserted in a branch line, or a derived line of any galvanic circuit, without interfering with the action of the said galvanic circuit. Fourthly, in a method of constructing a telephone so as to be able to dispense with a diaphragm of iron or other similar material, capable in itself of producing, when vibrating, induced currents in an electro-magnet in proximity thereto.

1477. "Telephonic apparatus." H. J. HADDAN. (A Communication from G. Black, of Hamilton, and Albert Mulholland Roseburgh, of Toronto). Dated April 16. 6d. This relates more particularly to a method of using a condenser, or in lieu thereof, a resistance medium or its equivalent, so that a telephone and an induced current signal apparatus may be connected with the wire of a galvanic circuit without interrupting the action of the said galvanic circuit. It includes:—A method of attaching two or more branch lines to a galvanic circuit, so as to establish a telephone circuit. Secondly, a method of connecting two or more parallel telegraph wires, and using them as a single conductor for a telephone line, for the double purpose of reducing the resistance of the line, and diminishing the injurious effects of foreign induced currents, as well as to be able to use wires that are also used for ordinary telegraph purposes. Thirdly, a method of connecting two or more parallel telegraph wires, so as to establish an induced current circuit without grounding. Fourthly, a method of connecting two or more independent galvanic circuits, so as to be able to utilise the wires of the said galvanic circuits for the construction of an induced current circuit. Fifthly, a method of grounding a telephone line at pleasure. Sixthly, a method of interrupting a galvanic circuit for the purpose of signalling without breaking the induced current circuit when telephones are used on the same lines. And Seventhly, an automatic circuit closer, so arranged that when the telephones are not in use the galvanic circuit is kept automatically closed.

1668. "Portable magnetic appliances." THOMAS WELTON. Dated April 28. 4d. Has for its object the union or adaptation of portable magnets, in conjunction with medicinal substances, to the various parts and all parts of the human body, for the alleviation and cure of diseases, and consists of horse-shoe magnets, or thin plates, or bars of steel, or woven steel wire, or woven wire cloth, or steel filings imbedded in, or covered by, any suitable medicinal substance, and laid on cloth, leather, or any pliant material.

2011. "Electro-magnetic pens." JOSHUA MOSES JOSIAS. Dated May 20. 6d. Consists of an electro-magnetic puncturing pen, constructed with the puncturing-needle, the electro-magnet, and the battery, so that they form one compact portable instrument, all the parts thereof being enclosed or shielded in a suitable case capable of being conveniently carried in the pocket like an ordinary writing-pen, and also consists in a roller saturated with a suitable ink or colour, and provided with an internal loose weight to press out the ink or colour for printing through the punctured plate or paper upon the required material.

2705. "Mariner's compass." W. R. LAKE. (A communication from Stephen Longfellow, of Philadelphia). Dated July 3. 6d. Consists in certain improvements in methods of, and devices for, preventing the deviation of the compass-needle from its proper direction, caused by the effects of local attraction, and to certain improvements in weighting or ballasting the compass bowl, and thus obviating the necessity of having two compasses, the one heavy and the other light.

A LARGE ELECTRO-MAGNET.—Mr. Charles Reitz, of Indianapolis, Ind., says the *Scientific American*, sends us a description of a large electro-magnet made by him for Professor Zahm, of the University of Nôtre Dame. The length of the cores is 30 inches, diameter 4 inches. Heads, of rubber, ½ inch thick, 9 inches in diameter. The yoke is 3¾ inches thick, 6½ inches wide, and 18 inches long, with 3-inch slots to admit of moving

the cores. The bolts which connect the cores with the yoke are $1\frac{1}{4}$ inches in diameter. The cores are wound with eight layers of No. 6 cotton-covered copper wire, the wire being wound double, and the alternate layers being provided with terminals, which are connected with a plug switch on the baseboard, so that the electric current may be sent through the coils in various ways. The magnet is provided with two sets of pole extensions for diamagnetic experiments, one set being conical, the other flat. The armature is 15 inches long, 3 inches thick, and 4 inches wide. Different effects may be produced in this magnet by connecting the coils with the battery in different ways. The changes that may be made in this way are almost without number. It is estimated that the magnet, with proper battery power, will lift three tons. The weight of the magnet and its attachments is 800 pounds.

THE DEPHOSPHORISATION OF IRON.—The adoption of the Thomas-Gilchrist process for the dephosphorisation of iron at Messrs. Bolckow, Vaughan, and Co.'s works at Eston has been followed by its introduction in Germany. Operations have there been carried out by the Hœrder Hütten Verein, at their Bessemer works, near Dortmund, in Westphalia, where the manufacture of the basic bricks is also carried out. A very low grade of pig iron has been used, containing an average of 14 per cent. of phosphorus and about an equal amount of silicon. In some charges a white pig, containing nearly 2 per cent. of phosphorus and but little over 1 per cent. of silicon, has been employed. The phosphorus in the steel produced from this pig is reported to average ·06 per cent., the silicon in all cases being *nil*. As might be expected, the steel produced is of peculiarly high quality, has in every case rolled and forged well, and has given the most satisfactory results when tested under a falling weight and in the testing machine. It may be mentioned that in no case has there been any lack of heat in the metal, notwithstanding the low percentage of silicon in the charge. That a very high percentage of phosphorus and a low percentage of silicon are no obstacles to the successful conversion of pig into Bessemer steel of the best quality under the Thomas process is demonstrated by these results.

WE have received from Mr. Edward Paterson, of Bedford Court, Covent Garden, a copy of his new catalogue of apparatus suitable for scientific lectures. It includes a list of apparatus for lectures, the cost to hire or to purchase same, also an extensive list of slides for magic lantern to illustrate lectures on Natural Philosophy and Experimental Physic, Magnetic Curves, Sound, the Telephone, Microphone, Phonograph, etc.; Lamps, Magneto and Dynamo-electric Machines, and Application of the Electric Light; Human Physiology, Astronomy, Spectrum Analysis, Light, and Underground Life, or Mines and Miners. To all who lecture on scientific subjects, or who use the lantern for teaching or amusement, the book must prove of great service and interest.

The following are the final quotations of telegraphs for 27th Nov.:—Anglo-American, Limited, $55\frac{1}{2}$-$56\frac{1}{2}$; Ditto, Preferred, 81-82; Ditto, Deferred, 31-32; Brazilian Submarine, Limited, $7\frac{3}{8}$-$7\frac{5}{8}$; Cuba, Limited, 8-$8\frac{1}{2}$; Cuba, Limited, 10 per cent. Preference, 15-16; Direct Spanish, Limited, 2-$2\frac{1}{2}$; Direct Spanish, 10 per cent. Preference, $11\frac{1}{4}$-$11\frac{3}{4}$; Direct United States Cable, Limited, 1877, $10\frac{1}{4}$--$10\frac{1}{2}$; Eastern, Limited, $8\frac{3}{8}$-$8\frac{5}{8}$; Eastern, 6 per cent. Debentures repayable Oct., 1883, 102-105; Eastern 5 per cent. Debentures repayable Aug., 1878, 102-104; Eastern, 6 per cent. Preference, $11\frac{7}{8}$-$12\frac{1}{8}$; Eastern Extension, Australasian and China, Limited, $8\frac{3}{8}$-$8\frac{5}{8}$; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 106-109; 5 per cent. Australian Gov. Subsidy Deb. Scrip, 1900, $\frac{1}{2}$-$1\frac{1}{2}$ pm; Ditto, registered, repayable 1900, 1-2 pm; German Union Telegraph and Trust, $7\frac{1}{2}$-8; Globe Telegraph and Trust, Limited, $4\frac{7}{8}$-$5\frac{1}{8}$; Globe, 6 per cent. Preference, 11-$11\frac{1}{4}$; Great Northern, $8\frac{1}{2}$-$8\frac{3}{4}$; Indo-European, Limited, $22\frac{1}{2}$-$23\frac{1}{2}$; Mediterranean Extension, Limited, $2\frac{3}{4}$-$3\frac{1}{4}$; Mediterranean Extension, 8 per cent. Preference, $9\frac{3}{4}$-$10\frac{1}{4}$; Reuter's Limited, $9\frac{1}{2}$-$10\frac{1}{2}$; Submarine, 230-240; Submarine Scrip, $2\frac{1}{8}$-$2\frac{3}{8}$; West Coast of America, Limited, 1-$1\frac{1}{2}$; West India and Panama, Limited, $1\frac{3}{8}$-$1\frac{5}{8}$; Ditto, 6 per cent. First Preference $7\frac{1}{4}$-$7\frac{3}{4}$; Ditto, ditto, Second Preference, $6\frac{3}{4}$-$7\frac{1}{4}$; Western and Brazilian, Limited, $4\frac{3}{4}$-5; Ditto, 6 per cent. Debentures "A," 98-101, Ditto, ditto, ditto, "B," 96-100; Western Union of U.S. 7 per cent., 1 Mortgage (Building) Bonds, 120-125; Ditto, 6 per cent. Sterling Bonds, 105-107; Telegraph Construction and Maintenance, Limited, $34\frac{1}{2}$-$35\frac{1}{2}$; Ditto, 6 per cent. Bonds, 106-108; Ditto, Second Bonus Trust Certificates, $2\frac{3}{4}$-3; India Rubber Co., $12\frac{3}{4}$-$13\frac{1}{4}$; Ditto, 6 per cent. Debenture, 105-107.

TRAFFIC RECEIPTS.

Name of Co., with amount of issued capital, exclusive of preference and debenture stocks.	Anglo-American Co. £7,000,000.	Brazilian Sub. Co. £1,300,000.	Cuba Sub. Co. £160,000.	Direct Spanish Co. £116,379.	Direct U.S. Co. £1,213,900.	Eastern Co. £3,697,000.	Eastern Ex. Co. £1,997,500.	Gt. Northern Co. £1,500,000.	Indo-Euro. Co. £425,000.	Submarine Co. £338,225.	West Coast America Co. £300,000.	Western and Brazilian Co. £1,398,200	West India Co. £883,210.
	£	£	£	£	£	£	£	£	£	£	£	£	£
October, 1879...	80,490	*16,158	3,000	1,371	26,830	50,251	31,419	21,987	... ...	a	... ...	*14,209	4,606
October, 1878 ...	54,150	13,138	2,835	1,107	18,050	41,678	23,393	19,737	... ...	10,823	2,750	a	5,016
Increase	26,340	3,020	165	264	8,780	8,573	8,026	2,250	... ...	... ...	... ...	... ...	... ...
Decrease	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	410

* Five weeks. *a*, not published.

TELEPHONES

(HICKLEY'S PATENT).

Wholesale and Retail Agents,

M. JACKSON & CO.

(J. Orme & H. M. Capner).

These Telephones are acknowledged to be perfect for practical use in connecting offices, mines, &c. They are now in use upon many lines, and are never known to fail.

Price Lists of every description of SCIENTIFIC APPARATUS and CHEMICALS, post free for three stamps each.

Enclose Business Card for Trade Terms.

£2 10s. per pair.

65, BARBICAN, LONDON, E.C.

JOHNSON & PHILLIPS,

ELECTRIC CARBON WORKS,

BELVEDERE, LONDON, S.E.

BLACK AND COPPERED CARBON RODS. Also BATTERY PLATES.

THE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW,

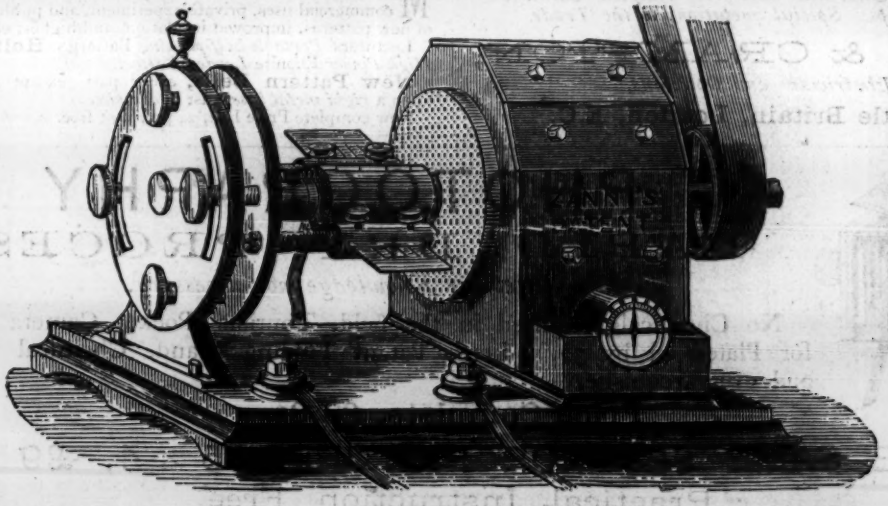
Handsomely bound in cloth, gilt, Vols. I., II., III., IV., V., and VI. Price 10s. 6d. each. Nearly all the back numbers may be had through any Bookseller, or of the Publishers. Subscribers' numbers bound in black cloth, gilt, 2s. 6d. Binding Cases, 2s.

HAUGHTON & CO., 10, PATERNOSTER ROW, E.C.

ZANNI & BRIDGER,

ELECTRICAL INSTRUMENT MANUFACTURERS,

1, JAMES STREET,



OLD STREET, LONDON, E.C.

MAKERS of ZANNI'S PATENT DYNAMO MACHINES for ELECTRO PLATING and TYPING.

ELECTRIC TELEGRAPH WORKS,

CHIPPENHAM MEWS, HARROW ROAD, PADDINGTON.

To Engineers, Telegraph Instrument Makers, Electric Bell Manufacturers, Builders, and others.

Messrs. GRAVES & SON will Sell by Auction on the Premises, as above, on Tuesday, December 9th, at 11 o'clock prompt, the whole of the Plant, Machinery, Tools, Stock, and Fixtures, comprising Planing Machine, Shaping Machine, Band-sawing and Wood-planing Machine, Circular Saw Benches, Lathes, Drilling and other Machines, Shafting, Belting, a large assortment of Tools, and a quantity of Telegraph Stores, Fittings and Material. To be viewed day prior to and morning of sale. Catalogues to be obtained on the Premises, or at the Auctioneer's Offices, 44, Talbot Road, Paddington, W.

ELECTRICAL AND EXPERIMENTAL APPARATUS.

MR. J. C. STEVENS has received instructions from the BRITISH TELEGRAPH MANUFACTORY COMPANY (LIMITED) to SELL by AUCTION, at his Great Rooms, 38, King Street, Covent Garden, on FRIDAY, DECEMBER 5, at half-past 12 precisely, the STOCK, PLANS, MATERIALS, and INSTRUMENTS belonging to some of their departments; they include many kinds of electric, telegraphic machines, and other scientific apparatus, and the implements and materials for making the same. Also many experimental and perfected instruments connected with the inventions of Wheatstone, Morse, Pelletier, which would be interesting and useful for colleges, museums, and lecture-rooms. Gramme light and plating machines, lathes, tools, anvils, vices, wire, materials and chemicals for batteries, magnets, galvanometers, bridges, rheostats, A B C instruments, cyrtographs, calculating machines, electric clocks, magnets, bells and pulls, lightning dischargers, &c., &c. May be viewed after 2 o'clock the day prior and morning of sale, and catalogues had.

ELECTRICAL & SCIENTIFIC APPARATUS.

WHOLESALE MANUFACTURERS OF ELECTRIC BELLS.

Our New Perfected Pattern Mounted entirely on Metal.

Improved Indicators and Automatic Telephone Switches.

INDUCTION COILS of highest finish. Carbons, Wire, and all materials.

SILVER AND NICKEL PLATING AND GILDING.

Instruments made, repaired, or altered on the premises.

Illustrated Electric Bell List free, complete Catalogue Two Stamps. Special quotations to the Trade.

DALE & CRAMPTON,

Electricians and Opticians,

4, Little Britain, London, E.C.

T. WIESENDANGER'S

CLASSES IN PRACTICAL SCIENCE.

ELECTRICITY and MAGNETISM, Thursdays, 7·30 to 8·30; ACOUSTICS, LIGHT and HEAT, Thursdays, 8·30 to 9·30. Fee for the two courses, 9/- per Term in advance. All lectures are fully illustrated. Appliances for constructing Apparatus.

33, NEW BRIDGE STREET,

LUDGATE CIRCUS.

ELECTRICITY. ELECTRICITY. ELECTRICITY.

GEO. G. BLACKWELL

PREPARES specially the MANGANESE for use in Leclanché and other Batteries; guaranteed pure, strong, and certain action.

Manganese and Mineral Works, Garston.

Offices—5, CHAPEL STRET, LIVERPOOL.

F. H. BROOK, ELECTRICIAN,

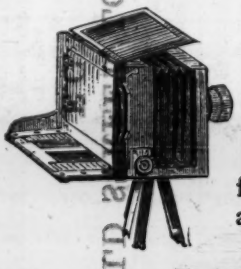
107, Lorrimore Road, Walworth, S.E.,

MANUFACTURER of Voltaic and Frictional Apparatus, for commercial uses, private experiment, and public demonstration of new patterns, improved insulation, and highest efficiency.

Lecturers' *Portable Self-packing* Batteries, **Holtz Machines,** *High Power* Ebonite *Leyden Batteries.*

New Pattern Bells, every part, except terminals, fitted upon a *rigid metal base,* cast in *one piece.*

New complete Price List, 24 pp., post free. *Special Trade Terms.*



PHOTOGRAPHY

(RAPID DRY PROCESS).

Previous Knowledge not necessary.

No Chemicals required in the field, Tourists' Pocket Camera and Slides, for Plates 4¼ by 3¼. Lens, Patent Folding Stand, Chemical Laboratory, and every requisite.

Price Complete, £8 8s.

THE SAME SET FOR PICTURES 5 × 4, £9 9s.

Practical Instruction Free.

Sensitive Plates 2s. 6d. per doz.

WRATTEN & WAINWRIGHT,

EDWARD PATERSON,

MANUFACTURING HELIOTRICIAN,

3, BEDFORD COURT, COVENT GARDEN.

STEAM WORKS—GRAY'S INN ROAD.

EXPERIMENTS IN ELECTRIC LIGHTING CARRIED OUT.

PATERSON'S ELECTRIC LAMP & BATTERY, for experiments with the Electric Light, &c. &c.

APPARATUS FOR SCIENCE SCHOOLS AND LECTURE PURPOSES.

RUHMKORFF COILS AND VACUUM TUBES.—Purchasers of more than £5 value of these can see them tested before purchasing.

Telephones, Telephone Cells, Telephone Wires, Electric Bells, Indicators, and Pushes.

SIEMENS' & GRAMME'S' DYNAMO-MACHINE and LAMPS on Hire.

PROFESSOR S. P. THOMPSON'S LANTERN SLIDE GALVANOMETER, &c.

New Illustrated Catalogue of 60 pages, post free 6 stamps.

W. LADD & CO.,

SCIENTIFIC INSTRUMENT MANUFACTURERS

(By Appointment to the Royal Institution of Great Britain),

11 and 12, Beak Street, Regent Street, W.

IMPROVED HOLTZ ELECTRICAL MACHINES, with 4 to 24 Plates. Immediately available in any condition of the atmosphere.

LADD'S DYNAMO-MAGNETO MACHINE and GRAMME'S MAGNETO-ELECTRIC MACHINE for Laboratory use.

Physical Apparatus of every Description.

ILLUSTRATED CATALOGUE, SIXPENCE.

THE PATENT ROBEY "ELECTRIC LIGHT" ENGINE.

PARIS, 1878.
GOLD MEDAL.

SOME OF THE ADVANTAGES OF THIS ENGINE ARE:—

Small Cost of Time and Attendance.
Perfect Steadiness of Light.
Small Consumption of Fuel.
Ease in Working.

ROBEY & Co.'s ELECTRIC LIGHT ENGINES

Patent High Speed Governor.
The Greatest Regularity and Steadiness in working.

Portable of 4 to 200 Horse-Power always in stock at its address. Photographs, with particulars and terms on application to the Head Quarters, Lincoln.

ROBEY & Co., Engineers, Lincoln, England;

LONDON OFFICE, 117, CANNON STREET, E.C.

AN ARTIFICIAL SUN MAY BE HAD AT ANY TIME BY APPLYING TO THE ABOVE FIRM.

POWER TO BE SUPPLIED.

W. M. WARDEN & Co.,

TELEGRAPH ENGINEERS AND CONTRACTORS,

27, GREAT GEORGE STREET WESTMINSTER, S.W.

Contractors for the Erection and Complete Equipment of Lines of Telegraph, and for the Supply of Telegraph Stores.

MANUFACTURERS OF IRON POLES AND TELEGRAPH WIRE.

ALSO OF EVERY DESCRIPTION OF

TELEGRAPH INSTRUMENTS AND APPARATUS.

W. M. WARDEN, of the late Firm of Warden, Muirhead and Clark.

APPS, 433, STRAND, LONDON.

Telegraphic Engineer and Contractor. **Needle**, Morse, Alphabetical, Sounders and recording Telegraphic Instruments. **Batteries**, Lines, Cables, Insulators, Semaphores, **Torpedo** Apparatus, Mine Exploders, **Fuzes**, Dynamite, Gun Cotton. **Ebonite** Manufactures of all kinds; Sheet, Tube and Rod Cut to Order for Manufacturers and Amateurs, and all Materials for **Scientific Apparatus, Surveying, Nautical, Mechanical, Optical, Electrical, Acoustic** and Scientific Instruments of all kinds. Apps' Patent Induction Coil, 1 inch to 60 inch, Spark in Air, **Vacuum** Tubes and Apparatus. ELECTRIC LIGHT. Contracts for Supply and Maintenance, &c. **Telephonic** Bell and **Pneumatic** Communicators laid and maintained. **Apps'** New **Constant** Medical Battery. **Bagot's** Patent Mining Signal Apparatus for Shafts and Engine Planes. **Bagot's** Patent Temperature Recorder and Alarum for Wineries, Ship's Cargoes, &c. **Patents** and **Models** of Inventions.

INDIA-RUBBER, GUTTA-PERCHA, AND TELEGRAPH WORKS COMPANY, LIMITED.

Offices and Warehouses: 106 & 100, CANNON ST., LONDON, E.C.

Works: Silvertown, Essex; Persan Beaumont, France.

TELEGRAPH ENGINEERS AND MANUFACTURERS OF

CABLES.—Submarine, Subterranean, and Aërial.

WIRE.—India-Rubber and Gutta-Percha covered in all gauges.

INSTRUMENTS.—"Morse" Inkers, Single Needle, Wheatstone's Alphabetical, Preece's & Walker's system of Semaphore "Block" Instruments, Bells, Resistance Coils, Sir W. Thomson's and other Galvanometers, Condensers, Testing Instruments, &c.

BATTERIES.—SOLE MANUFACTURERS FOR GREAT BRITAIN, IRELAND, AND THE COLONIES OF THE CELEBRATED LECLANCHÉ BATTERY, which has received the most favourable reports from Telegraph Engineers, and is in general use on English and Continental Railways. As a Battery for all Telegraphic purposes it is undoubtedly pre-eminent. All other kinds of Batteries also manufactured. Ebonite Cells, Carbon Plates, &c.

The Leclanché is the best Medical Battery.

INSULATORS.—Ebonite, Porcelain, Brownware, &c.

MANUFACTURERS OF THE MOST IMPROVED APPARATUS FOR RAILWAY BLOCK-SIGNALLING.

SEMAPHORE REPEATERS "LIGHT" INDICATORS, AND WALKER'S "PASSENGER AND GUARD" COMMUNICATOR.

TELEGRAPH STORES AND APPARATUS OF EVERY DESCRIPTION.

TORPEDO APPARATUS.

THE INDIA-RUBBER, GUTTA-PERCHA, & TELEGRAPH WORKS COMPANY (Limited) are Patentees and Manufacturers of a Complete System of Torpedoes for Harbour and Coast Defence, and of the

SILVERTOWN PATENT FIRING BATTERY.

A Constant Battery for Mining and Blasting Purposes.

CONTRACTS ENTERED INTO for the SUPPLY, CONSTRUCTION, and MAINTENANCE of TELEGRAPH LINES.